

**Resource  
Inventory**

**for the**

**Aleutians East  
Coastal Resource  
Service Area**

**Volume II**

# PREFACE

The Aleutians East Coastal Resource Service Area is comprised of the western portion of the Alaska Peninsula from Cape Seniavin to the western tip of Unimak Island, including the offshore island groups south of the Alaska Peninsula from Kupreanof Peninsula to Unimak Pass. Along its 150-mile length, the area is interspersed with passes, bays, coves, lagoons, and islands creating an extensive, undulating coastline along both the North Pacific Ocean and the southern Bering Sea. The coastal resources of the area provide a significant contribution to the regional, state, and national economies, most notably through its fisheries.

The Federal Coastal Zone Management Act of 1972, and the Alaska Coastal Management Act of 1977, provide a framework to plan for the wise use, orderly development, and conservation of coastal resources. The State of Alaska Legislature established a procedure to allow local governments to form coastal districts and manage development within their coastal jurisdiction. As part of this process, the districts are required to prepare a District Coastal Management Plan.

In October 1981, residents of Sand Point, King Cove, False Pass, Cold Bay, and Nelson Lagoon voted to organize the Aleutians East Coastal Resource Service Area (CRSA). In May 1982 seven individuals from the five communities were elected to serve on the Aleutians East CRSA Board. In January 1983, this Board began development of a coastal management program that meets the requirements of the Alaska Coastal Management Program. As one step in satisfying the program guidelines, this Resource Inventory has been prepared.

The purpose of the Resource Inventory is to provide an overview of the coastal habitats, fish and wildlife resources, commercial fishing industry, mineral resources, natural hazards, communities, and cultural resources within the Aleutians East CRSA. The inventory also identifies and locates important resource values within the Aleutians East region and provides a data base upon which an analysis of potential development activities can be prepared. From these products, coastal management policies can be formulated.

The Resource Inventory summarizes published and unpublished information concerning the natural and human resources of the Aleutians East CRSA. It is not intended to be a comprehensive treatise, but rather a working document which provides the coastal planner with an overview of vital resource areas, sensitive coastal habitats, natural hazard areas, and vulnerable fish and wildlife use areas and life history stages in both a mapped and narrative format.

---

# **CHAPTER 1**

## **Coastal Description and Coastal Habitats**

---

### **COASTAL DESCRIPTION**

The Aleutians East Coastal Resource Area encompasses the western limits of the Alaska Peninsula from Cape Seniavin to Unimak Pass and the offshore islands to the south of the Peninsula (Map A). The area is comprised of two physiographic provinces; the Bristol Bay Lowlands adjoining the Bering Sea along the north shore of the Peninsula, and Aleutian Range bordering the Gulf of Alaska along the southern portion of the Peninsula. Major island groups offshore in the Gulf of Alaska include Sanak Island, Sandman Reefs, Deer Island, Pavlof Islands, and the Shumagin Islands.

The elongated, narrow landform of the Alaska Peninsula and the multitude of islands contained within the Aleutians East CRSA suggest the importance of the maritime influence upon the climate, vegetation, and biological resources of the region. The presence of the Alaska Peninsula land mass separates the waters of the northern Pacific Ocean (Gulf of Alaska) from the southern Bering Sea and Bristol Bay.

The coastal plain of the Bristol Bay Lowlands is relatively flat with elevations generally less than 1,000 feet above sea level. The uplands, plateaus, and low mountains of the Aleutian Range vary from 1,000 to 5,000 feet above sea level. High rugged mountains of tectonic and volcanic origin with summits exceeding 5,000 feet are present throughout the length of the Aleutians East CRSA (Hartman and Johnson 1978). Batten and Murray (1982) characterized the topography as comprised of wave-cut platforms bordered by low sea cliffs, intensely glaciated mountains indented with fjords and bordered by cliffs, and volcanic peaks of which the highest bear ice caps or small glaciers. Adjoining the eastern boundary of the Aleutians East CRSA, the volcanic peak of Mount Veniaminof rises to 8,225 feet. West of Pavlof Bay, Mount Pavlof reaches an elevation of 8,261 feet. Separated from the Alaska Peninsula by the narrow passage of False Pass, Unimak Island is dominated by five volcanoes including Shishaldin (9,387 feet) and Isanotski Peaks (8,025 feet). Unimak Pass, the western boundary of the Aleutians East CRSA, is a ten- to twenty-mile wide strait between the Pacific Ocean and the Bering Sea.

### **Climate and Weather**

The Aleutians East CRSA lies in two climatic zones: the South Peninsula and offshore islands are included in the Maritime Zone and the North Peninsula is in the Transition Zone. Maritime climate is characterized by heavy precipitation, cool summers, warm winters, and persistently strong surface winds. Transitional climates have characteristics intermediate between maritime and continental climates with somewhat less precipitation and greater temperature extremes. The major climatic influences in the region are the oceanic waters that surround the Aleutians East CRSA and the high frequency of cyclonic storms that cross the North Pacific Ocean and Bering Sea.

**Table 1-1: Temperature, precipitation, wind, and visibility in selected Aleutians East CRSA locations**

	LOCATION		
	COLD BAY	SAND POINT	PORT MOLLER
TEMPERATURE (°F)			
avg. annual maximum	44	44	42
highest	78	70	74
avg. annual minimum	33	35	28
lowest	- 12	0	- 10
PRECIPITATION (in.)			
total	33	63	44
snowfall	52	85	92
percent frequency (%)	35	*	59
WIND (knóts)			
avg. annual speed & direction	17 SSE	*	8.7 S
fastest speed & direction	73 SSE	*	55 S
VISIBILITY			
% frequency obstructions to visibility <sup>1</sup>	18.4	*	26.4

\* no data available

<sup>1</sup>from fog, haze or smoke, or blowing snow

Source: Brower et al. 1977

In the Gulf of Alaska, coastal waters overlying the continental slope are subject to considerable seasonal variation. Winter cooling accompanied by turbulence and mixing from major storms results in uniformly cold water (about 4°C or 40°F) in the upper 100-m of the water column. During the winter, surface water piles up in coastal areas in the path of prevailing storms and low pressure systems; this produces a compensating flow seaward along the sea bottom. With the shift in wind direction and decrease in wind intensity during the summer, there is a surface seaward flow of water and a compensating transport and upwelling of nutrient-rich subsurface water shoreward across the continental shelf. During the summer, higher air temperatures and river runoff result in the formation of a stratified water column where surface temperatures can reach 12°C or 50°F (Morris et al. 1983).

The southeastern Bering Sea is characterized by three hydrographic domains, and relatively little mixing occurs between domains. The coastal domain is bounded by the shoreline and the 50-m isobath (depth contour). Temperatures, salinity, and other water properties are homogeneous due to mixing of bottom waters by tides and the surface waters by winds. A considerable volume of fresh water is added to the coastal waters of this region by numerous rivers and streams. Typical summer conditions are 30 parts per thousand (ppt) salinity and 6.5°C (44°F) temperature. The seaward front of the coastal domain is narrow (about 10 km wide) relative to the domains it separates which are each about 50 km wide.

The middle shelf hydrographic domain begins at the 50-m isobath and extends seaward to approximately the 100-m isobath. The middle shelf domain is two-layered, with the upper layer warmer and less saline than the lower layer. The upper layer is typically 15- to 20-m thick and is mixed by wind stirring. During the summer salinity is typically 31.7 ppt and temperature is 3.6°C (40°F). The bottom layer is typically 50-m thick and mixed by tidal energy.

Seaward of the middle shelf domain is the outer shelf domain which extends from about the 100-m isobath to the shelf break (about 170-m). A broad and weak front separates these two hydrographic domains. As in the middle shelf domain, the waters of the outer shelf have a layered structure. There is a similar but more saline and warmer surface layer, a middle layer (20- to 80-m depth), and a deep layer. Intermixing of shelf and oceanic waters occurs in the outer shelf domain. Another broad, weak front separates the outer shelf domain from the oceanic domain (Science Applications, Inc. 1981).

### **Water Quality**

Water quality within the Aleutians East CRSA marine waters is excellent. Background hydrocarbon studies conducted in the Bering Sea to the north of the Aleutians East CRSA found no evidence of petroleum contamination. Existing levels of low molecular weight hydrocarbons were concluded to be biologically formed. Assessments of heavy metal distributions in Aleutians East CRSA waters and sediments have also been made, and ambient concentrations were found to be variable but typical of mid-latitude regions. In general, concentrations of heavy metals in the Bering Sea are lower than in the Gulf of Alaska (Science Applications, Inc. 1981).

### **Biological Importance**

The offshore areas of the Aleutians East CRSA are extremely productive marine systems which are critical to the fish and wildlife populations dependent upon the area for breeding, spawning, nesting, migration, and feeding activities. For the people of the region, the resources of the offshore areas provide an integral part of their livelihood and lifestyle.

Extensive populations of seabirds and waterfowl are dependent upon the abundant sources of food available in this area. Gusey (1979) noted that the enormous population of pelagic birds using the area is more varied than in any other region of North America.

Approximately 300 species of marine fish occur in offshore areas of the Bering Sea; half of these fish are demersal species which inhabit inner and middle shelf waters (USDI 1982).

Unimak Pass is a critical migration route for many species of fish and marine mammals, including the endangered gray whale and a significant proportion of the Bristol Bay salmon run.

## **ESTUARIES**

Estuaries are bodies of coastal water which are measurably diluted with freshwater supplied by drainage from rivers and streams. Estuaries include the brackish waters of barrier island lagoon systems and coastal deltas, bays, and inlets extending upstream in watercourses to the limit of saltwater intrusion. Salinity measurements for bays and river mouths in the Aleutians East area are generally lacking. The seaward limit of estuarine areas has been delineated as a line connecting the headlands of deltas or bays emptying directly into the ocean. Due to the significant input of freshwater and glacial silt from the major rivers of the north Peninsula and Bristol Bay, estuarine waters are also considered to extend eastward in a coastal band 5 to 50 miles offshore along the north shoreline of the Peninsula from approximately Otter Point on Unimak Island to the eastern boundary of the Aleutians East CRSA. Estuarine waters as delineated by the Alaska Department of Fish and Game (ADF&G) are shown on Map A.

Many of the rivers of the Alaska Peninsula within the Aleutians East CRSA drain to the north into Bristol Bay, and numerous rivers empty into estuarine lagoon systems along the coast. This freshwater input, combined with significant contributions of freshwater from other Bristol Bay rivers and streams, produces an extensive plume of estuarine waters in the offshore areas of Bristol Bay adjacent to the Aleutians East CRSA (Map A).

The bays and lagoons of the north Peninsula are among the most expansive and biologically productive estuarine systems in the state (Thorsteinson 1984). These estuaries support plants and invertebrates which are a key source of food for many birds. The estuarine food web is based on detritus deposited on tidal flats which is subsequently used by bottom feeders, filter feeders, and burrowers.

The Nelson Lagoon complex, which includes Nelson Lagoon, Herendeen Bay, and Port Moller covers 208 square miles and is the largest estuarine area along the shoreline of Bristol Bay (Gusey 1979). The principal source of freshwater input is derived from the combined discharges of the Caribou and

Sapsuk Rivers which enter the western end of Nelson Lagoon. Smaller drainages contribute freshwater along the shoreline and headlands of Herendeen and Moller Bays. Gusey (1979) noted a diverse population of birds utilizing this area which exceeded the diversity of use observed for all other estuarine areas of the Peninsula. The Nelson Lagoon complex is usually ice-free between late April and early October when the Bering Sea ice front extends south toward Port Moller during the winter (Gill et al. 1981).

## BARRIER ISLANDS AND LAGOONS

Barrier islands and lagoons are depositional coastal environments formed by offshore sediments or coastal remnants which develop as a barrier of low-lying islands, bars, or spits protecting a salt-water lagoon that is subjected to periodic or continuous exchange of water with the ocean. Lagoon waters are generally estuarine, and tideflats are commonly present within lagoons. Low islands, bars or spits with sand or mud deposits, and partially enclosed bays and lagoons are included in this coastal habitat category. Barrier islands and lagoons within the Aleutians East CRSA have been identified from the Alaska Intertidal Survey Atlas (Sears and Zimmerman 1977) and National Oceanic and Atmospheric Administration (NOAA) navigation charts. The presence of barrier island and lagoon systems identified by ADF&G are shown on Map A.

Three major lagoon systems are found along the north side of the Alaska Peninsula within the Aleutians East CRSA: (1) Bechevin Bay, (2) Izembek and Moffet Lagoons, and (3) the Nelson Lagoon complex comprised of Nelson Lagoon, Mud Bay, Herendeen Bay, and Port Moller. Collectively, these major lagoon systems provide more than 550 square miles of lagoon habitat (Kint et al. 1981). The larger lagoons can have tidal exchanges equivalent to the flow volume of major river systems. Gusey (1979) has reported that the biological productivity of these lagoons is significantly greater than equivalent areas of the Bering Sea.

The lagoons of the North Peninsula are partially shielded from coastal inundations by sandy barrier islands and protective sand spits located at their entrances. Circulation patterns inside bays and lagoons are complex, influenced by winds and tides. Although these specific processes are largely unstudied, the net transport is apparently outward. The influence of exported nutrients and detritus on the coastal ecology is unknown but is suspected to provide a substantial influence on nearshore benthic stocks. In-depth descriptions of the more extensive North Peninsula lagoon systems are presented in the North Aleutian Shelf Synthesis Report (Thorsteinson 1984).

Extensive beds of eelgrass (*Zostera marina*) have developed in the shallow protected waters of the lagoons. Izembek Lagoon supports the largest eelgrass bed in the world (McRoy 1968). This embayment occupies nearly 50 miles of coastline with approximately 70 percent of its area covered by eelgrass beds. The productivity of this system is high with the standing stock of eelgrass averaging 8.2 tons per acre (AEIDC 1976). Nutrient cycling within the Izembek Lagoon system is highly dependent on eelgrass detritus, the primary source of organic matter in the sediments which sustain eelgrass growth.

Eelgrass beds are recognized as vital to the survival and welfare of black brant and emperor geese, and possibly Steller's eider (King and Lensink 1971). The aquatic vegetation and abundant benthic fauna create ideal habitats which provide important migration staging areas during the spring and fall for waterfowl and shorebirds. Twenty-five species of waterfowl have been identified using the lagoon habitat of Nelson Lagoon (Gusey 1979).

Except for major barrier island and lagoon systems at the head of Morzhovoi Bay and Cold Bay, the South Peninsula coastline abutting the Gulf of Alaska exhibits only small, scattered barrier island and lagoon systems due to the topography of the land and the presence of nearly continuous high energy coastline, rocky islands, and seacliffs.

## WETLANDS AND TIDEFLATS

Within the Aleutians East CRSA, "wetlands" encompass saltwater wetlands, freshwater wetlands, and tideflats. Wetlands in this area have been delineated using the Alaska Region U.S. Army Corps of Engineers regulatory definition:

*"Wetlands include those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil (substrate) conditions. Wetlands generally include swamps, freshwater and salt marshes, forested and treeless bogs, muskegs, wet and moist tundra, wet riparian corridors, and similar areas."*

Tideflats are primarily unvegetated areas that are alternately exposed and inundated by marine tidal changes.

The wetlands and tideflats of the Aleutians East CRSA have been identified from NOAA charts, U.S. Geological Survey (USGS) topographic maps, the Bristol Bay Cooperative Management Plan (BBCMP) vegetation and soil maps, and the Arctic Environmental Information and Data Center (AEIDC) Regional Profile vegetation maps. Where available, site-specific information from other reports was incorporated into the mapping effort. In general, vegetation communities identified as coastal marshes, wetlands, wet tundra, vegetated intertidal, tideflats, and unvegetated intertidal have been included in the areas defined as wetland and tideflat coastal habitat (Map A). Limitations of this approach to delineation of wetlands include the lack of site-specific information, the inclusion of small wetlands within other coastal habitat types (discontinuous wetlands), and the limitations imposed by mapping scale.

Within the Aleutians East CRSA, lowland peat tundra forms "wet meadows" with sedges and lichens as the most prevalent vegetation in the more poorly-drained areas (Batten and Murray 1982). Ephemeral pools (ponds and lakes underlain by peat) are present throughout the lowlands. A wet sedge meadow community typically occurs along the borders of lakes, on poorly-drained slopes, and adjacent to streams in heath vegetation communities.

Wet tundra communities are also common in the Bristol Bay lowlands (Batten and Murray 1982). Wet tundra is primarily confined to low-lying coastal areas, particularly along the Bristol Bay lowlands fronting the north shore of the Peninsula. Numerous ponds and lakes are distributed throughout the wet

Physical Oceanography

Tides: Tides in the Aleutians East CRSA are characterized as mixed semi-diurnal, i.e. there are two markedly unequal high and low tides each lunar day (approximately every 25 hours). Tidal range for various locations in the region are presented in Table 1-2. Tidal currents in the Aleutians East CRSA can be very strong, especially in passes between islands. Off Scotch Cap in Unimak Pass, the incoming Pacific tide has a velocity of 3.5 knots (Brower et al. 1977).

Table 1-2: Tidal ranges and heights in selected Aleutians East CRSA locations

Location	Diurnal Range <sup>1</sup> (ft.)	Maximum Diurnal Tide <sup>2</sup> (ft.)	Minimum Diurnal Tide <sup>2</sup> (ft.)	Maximum Tide <sup>3</sup> (ft.)	Minimum Tide <sup>4</sup> (ft.)
Cape Sarichef	5.0	6.9	0.0	6.6	- 1.1
Port Moller	10.8	16.5	5.7	12.9	- 3.9
Sand Point	7.3	11.7	1.0	9.0	- 2.4
Cold Bay	7.1	11.3	0.9	9.0	- 2.4

<sup>1</sup>Average difference in height between mean higher high water and mean lower low water in a single day

<sup>2</sup>Maximum and minimum differences between higher high water and lower low water that is predicted to occur during a year (1974)

<sup>3</sup>Highest tide predicted to occur at the location in feet above mean sea level

<sup>4</sup>Lowest tide predicted to occur at the location in feet; a negative number indicates a level below mean sea level

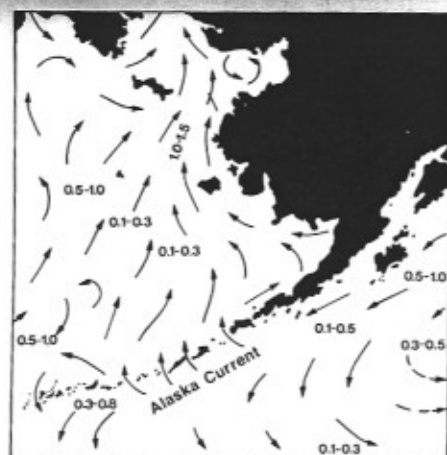
Source: Brower et al. 1977

Waves: Rough conditions are frequently encountered in Aleutians East CRSA marine waters. Hazardous wave conditions with waves greater than 12 feet in height occur year-round, but are more frequent from September through April (Brower et al. 1977).

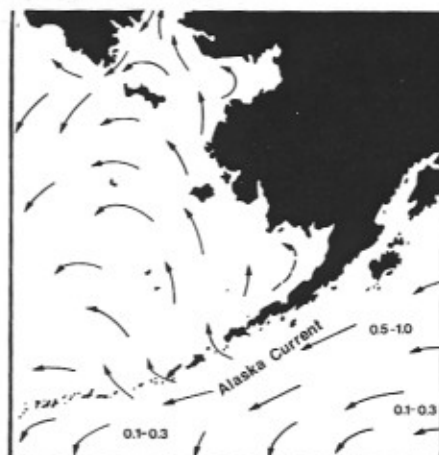
Water Circulation: The oceanic circulation patterns in the Aleutians East CRSA vicinity are only generally known with more information available about Bering Sea waters than Gulf of Alaska waters. Generalized surface current speed and direction in the area during both the summer and winter are illustrated in Figure 1-2.

Figure 1-2: Sea surface currents





SUMMER



WINTER

— PREVAILING CURRENT DIRECTION  
 - - - WEAK & VARIABLE CURRENT DIRECTIONS

Source: Brower et al. 1977

Nearshore Gulf of Alaska currents in the Aleutians East CRSA have not been systematically studied. Local currents may be strong and unpredictable, moving counter to general trends in many places. Freshwater discharge has been identified as a primary driving mechanism of local coastal circulation in the northwest Gulf of Alaska. Large freshwater discharges create a cross-shelf density gradient that drives an alongshore current which extends from Southeast Alaska to at least Kodiak Island. Apparently the flow is maintained as a narrow current adjacent to the coast by wind stress which causes downwelling conditions throughout most of the year (Royer 1982).

Seaward of the continental shelf in the Gulf of Alaska is the Alaska Stream, a permanent, strong westward surface flow of water. The rate of flow of the Alaska Stream varies seasonally with highest velocities reported during the winter. Alaska Stream waters penetrate into the Bering Sea, primarily through deep passes in the Aleutian Islands including Unimak Pass (AEIDC 1976). Recent studies, however, indicate flow reversals in Unimak Pass, especially during the summer when Bering Sea water may enter the Gulf of Alaska (Schumacher and Moen 1983).

There are three distinct flow regimes in the southeastern Bering Sea, and they are nearly coincident with the hydrographic domains. The coastal regime inshore of the 50-m isobath has a slow (1 to 5 cm/sec) counter-clockwise mean current and occasional wind-driven pulses of a few days duration. The middle regime (between the 50- and 100-m isobaths) has insignificant (1 cm/sec) mean flow but relatively stronger wind-driven pulses. The outer regime from the 100-m isobath to the shelf break has a 1 to 5 cm/sec westward flow (Kinder and Schumacher 1981). The dominant sources of energy for driving currents in the Bering Sea are tides and winds, with tides being the more important energy source, especially in waters less than 50-m deep (Science Applications, Inc. 1981).

**Hydrographic Structure:** The temperature and salinity regimes in both the Gulf of Alaska and Bering Sea adjacent to the Aleutians East CRSA follow seasonal patterns. As with tide and current information, less data are available for Gulf of Alaska waters than for the Bering Sea.

In the Gulf of Alaska, coastal waters overlying the continental slope are subject to considerable seasonal variation. Winter cooling accompanied by turbulence and mixing from major storms results in uniformly cold water (about 4°C or 40°F) in the upper 100-m of the water column. During the winter, surface water piles up in coastal areas in the path of prevailing storms and low pressure systems; this produces a compensating flow seaward along the sea bottom. With the shift in wind direction and decrease in wind intensity during the summer, there is a surface seaward flow of water and a compensating transport and upwelling of nutrient-rich subsurface water shoreward across the continental shelf. During the summer, higher air temperatures and river runoff result in the formation of a stratified water column where surface temperatures can reach 12°C or 50°F (Morris et al. 1983).

The southeastern Bering Sea is characterized by three hydrographic domains, and relatively little mixing occurs between domains. The coastal domain is bounded by the shoreline and the 50-m isobath (depth contour). Temperatures, salinity, and other water properties are homogeneous due to mixing of bottom waters by tides and the surface waters by winds. A considerable volume of fresh water is added to the coastal waters of this region by numerous rivers and streams. Typical summer conditions are 30 parts per thousand (ppt) salinity and 6.5°C (44°F) temperature. The seaward front of the coastal domain is narrow (about 10 km wide) relative to the domains it separates which are each about 50 km wide.

The middle shelf hydrographic domain begins at the 50-m isobath and extends seaward to approximately the 100-m isobath. The middle shelf domain is two-layered, with the upper layer warmer and less saline than the lower layer. The upper layer is typically 15- to 20-m thick and is mixed by wind stirring. During the summer salinity is typically 31.7 ppt and temperature is 3.6°C (40°F). The bottom layer is typically 50-m thick and mixed by tidal energy.

Seaward of the middle shelf domain is the outer shelf domain which extends from about the 100-m isobath to the shelf break (about 170-m). A broad and weak front separates these two hydrographic domains. As in the middle shelf domain, the waters of the outer shelf have a layered structure. There is a similar but more saline and warmer surface layer, a middle layer (20- to 80-m depth), and a deep layer. Intermixing of shelf and oceanic waters occurs in the outer shelf domain. Another broad, weak front separates the outer shelf domain from the oceanic domain (Science Applications, Inc. 1981).

## **Water Quality**

Water quality within the Aleutians East CRSA marine waters is excellent. Background hydrocarbon studies conducted in the Bering Sea to the north of the Aleutians East CRSA found no evidence of petroleum contamination. Existing levels of low molecular weight hydrocarbons were concluded to be biologically formed. Assessments of heavy metal distributions in Aleutians East CRSA waters and sediments have also been made, and ambient concentrations were found to be variable but typical of mid-latitude regions. In general, concentrations of heavy metals in the Bering Sea are lower than in the Gulf of Alaska (Science Applications, Inc. 1981).

## Biological Importance

The offshore areas of the Aleutians East CRSA are extremely productive marine systems which are critical to the fish and wildlife populations dependent upon the area for breeding, spawning, nesting, migration, and feeding activities. For the people of the region, the resources of the offshore areas provide an integral part of their livelihood and lifestyle.

Extensive populations of seabirds and waterfowl are dependent upon the abundant sources of food available in this area. Gusey (1979) noted that the enormous population of pelagic birds using the area is more varied than in any other region of North America.

Approximately 300 species of marine fish occur in offshore areas of the Bering Sea; half of these fish are demersal species which inhabit inner and middle shelf waters (USDI 1982).

Unimak Pass is a critical migration route for many species of fish and marine mammals, including the endangered gray whale and a significant proportion of the Bristol Bay salmon run.

## ESTUARIES

Estuaries are bodies of coastal water which are measurably diluted with freshwater supplied by drainage from rivers and streams. Estuaries include the brackish waters of barrier island lagoon systems and coastal deltas, bays, and inlets extending upstream in watercourses to the limit of saltwater intrusion. Salinity measurements for bays and river mouths in the Aleutians East area are generally lacking. The seaward limit of estuarine areas has been delineated as a line connecting the headlands of deltas or bays emptying directly into the ocean. Due to the significant input of freshwater and glacial silt from the major rivers of the north Peninsula and Bristol Bay, estuarine waters are also considered to extend eastward in a coastal band 5 to 50 miles offshore along the north shoreline of the Peninsula from approximately Otter Point on Unimak Island to the eastern boundary of the Aleutians East CRSA. Estuarine waters as delineated by the Alaska Department of Fish and Game (ADF&G) are shown on Map A.

Many of the rivers of the Alaska Peninsula within the Aleutians East CRSA drain to the north into Bristol Bay, and numerous rivers empty into estuarine lagoon systems along the coast. This freshwater input, combined with significant contributions of freshwater from other Bristol Bay rivers and streams, produces an extensive plume of estuarine waters in the offshore areas of Bristol Bay adjacent to the Aleutians East CRSA (Map A).

The bays and lagoons of the north Peninsula are among the most expansive and biologically productive estuarine systems in the state (Thorsteinson 1984). These estuaries support plants and invertebrates which are a key source of food for many birds. The estuarine food web is based on detritus deposited on tidal flats which is subsequently used by bottom feeders, filter feeders, and burrowers.

The Nelson Lagoon complex, which includes Nelson Lagoon, Herendeen Bay, and Port Moller covers 208 square miles and is the largest estuarine area along the shoreline of Bristol Bay (Gusey 1979). The principal source of freshwater input is derived from the combined discharges of the Caribou and

Sapsuk Rivers which enter the western end of Nelson Lagoon. Smaller drainages contribute freshwater along the shoreline and headlands of Herendeen and Moller Bays. Gusey (1979) noted a diverse population of birds utilizing this area which exceeded the diversity of use observed for all other estuarine areas of the Peninsula. The Nelson Lagoon complex is usually ice-free between late April and early October when the Bering Sea ice front extends south toward Port Moller during the winter (Gill et al. 1981).

## BARRIER ISLANDS AND LAGOONS

Barrier islands and lagoons are depositional coastal environments formed by offshore sediments or coastal remnants which develop as a barrier of low-lying islands, bars, or spits protecting a salt-water lagoon that is subjected to periodic or continuous exchange of water with the ocean. Lagoon waters are generally estuarine, and tideflats are commonly present within lagoons. Low islands, bars or spits with sand or mud deposits, and partially enclosed bays and lagoons are included in this coastal habitat category. Barrier islands and lagoons within the Aleutians East CRSA have been identified from the Alaska Intertidal Survey Atlas (Sears and Zimmerman 1977) and National Oceanic and Atmospheric Administration (NOAA) navigation charts. The presence of barrier island and lagoon systems identified by ADF&G are shown on Map A.

Three major lagoon systems are found along the north side of the Alaska Peninsula within the Aleutians East CRSA: (1) Bechevin Bay, (2) Izembek and Moffet Lagoons, and (3) the Nelson Lagoon complex comprised of Nelson Lagoon, Mud Bay, Herendeen Bay, and Port Moller. Collectively, these major lagoon systems provide more than 550 square miles of lagoon habitat (Kint et al. 1981). The larger lagoons can have tidal exchanges equivalent to the flow volume of major river systems. Gusey (1979) has reported that the biological productivity of these lagoons is significantly greater than equivalent areas of the Bering Sea.

The lagoons of the North Peninsula are partially shielded from coastal inundations by sandy barrier islands and protective sand spits located at their entrances. Circulation patterns inside bays and lagoons are complex, influenced by winds and tides. Although these specific processes are largely unstudied, the net transport is apparently outward. The influence of exported nutrients and detritus on the coastal ecology is unknown but is suspected to provide a substantial influence on nearshore benthic stocks. In-depth descriptions of the more extensive North Peninsula lagoon systems are presented in the North Aleutian Shelf Synthesis Report (Thorsteinson 1984).

Extensive beds of eelgrass (*Zostera marina*) have developed in the shallow protected waters of the lagoons. Izembek Lagoon supports the largest eelgrass bed in the world (McRoy 1968). This embayment occupies nearly 50 miles of coastline with approximately 70 percent of its area covered by eelgrass beds. The productivity of this system is high with the standing stock of eelgrass averaging 8.2 tons per acre (AEIDC 1976). Nutrient cycling within the Izembek Lagoon system is highly dependent on eelgrass detritus, the primary source of organic matter in the sediments which sustain eelgrass growth.

Eelgrass beds are recognized as vital to the survival and welfare of black brant and emperor geese, and possibly Steller's eider (King and Lensink 1971). The aquatic vegetation and abundant benthic fauna create ideal habitats which provide important migration staging areas during the spring and fall for waterfowl and shorebirds. Twenty-five species of waterfowl have been identi-

fied using the lagoon habitat of Nelson Lagoon (Gusey 1979).

Except for major barrier island and lagoon systems at the head of Morzhovoi Bay and Cold Bay, the South Peninsula coastline abutting the Gulf of Alaska exhibits only small, scattered barrier island and lagoon systems due to the topography of the land and the presence of nearly continuous high energy coastline, rocky islands, and seacliffs.

## WETLANDS AND TIDEFLATS

Within the Aleutians East CRSA, "wetlands" encompass saltwater wetlands, freshwater wetlands, and tideflats. Wetlands in this area have been delineated using the Alaska Region U.S. Army Corps of Engineers regulatory definition:

*"Wetlands include those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil (substrate) conditions. Wetlands generally include swamps, freshwater and salt marshes, forested and treeless bogs, muskegs, wet and moist tundra, wet riparian corridors, and similar areas."*

Tideflats are primarily unvegetated areas that are alternately exposed and inundated by marine tidal changes.

The wetlands and tideflats of the Aleutians East CRSA have been identified from NOAA charts, U.S. Geological Survey (USGS) topographic maps, the Bristol Bay Cooperative Management Plan (BBCMP) vegetation and soil maps, and the Arctic Environmental Information and Data Center (AEIDC) Regional Profile vegetation maps. Where available, site-specific information from other reports was incorporated into the mapping effort. In general, vegetation communities identified as coastal marshes, wetlands, wet tundra, vegetated intertidal, tideflats, and unvegetated intertidal have been included in the areas defined as wetland and tideflat coastal habitat (Map A). Limitations of this approach to delineation of wetlands include the lack of site-specific information, the inclusion of small wetlands within other coastal habitat types (discontinuous wetlands), and the limitations imposed by mapping scale.

Within the Aleutians East CRSA, lowland peat tundra forms "wet meadows" with sedges and lichens as the most prevalent vegetation in the more poorly-drained areas (Batten and Murray 1982). Ephemeral pools (ponds and lakes underlain by peat) are present throughout the lowlands. A wet sedge meadow community typically occurs along the borders of lakes, on poorly-drained slopes, and adjacent to streams in heath vegetation communities.

Wet tundra communities are also common in the Bristol Bay lowlands (Batten and Murray 1982). Wet tundra is primarily confined to low-lying coastal areas, particularly along the Bristol Bay lowlands fronting the north shore of the Peninsula. Numerous ponds and lakes are distributed throughout the wet

tundra communities, and standing water or a high water table is nearly always present due to the lack of topographic relief (AEIDC 1976). Typical plants present in wet tundra wetlands are listed in Table 1-3. Since the presence of wetland communities often has regulatory ramifications for development activities, a more detailed treatise of wetland classifications and characteristic plant communities has been developed for Alaska by Huffman and Tucker (1981).

**Table 1-3: Common plants of the coastal wet tundra community.**

Common Name	Scientific Name
Cottongrass	<i>Eriophorum angustifolium</i>
Sphagnum moss	<i>Sphagnum rubellum</i>
Bog orchid	<i>Platanthera dilatata</i>
Dwarf birch	<i>Betula nana</i>
Blueberry	<i>Vaccinium uliginosum</i>
Labrador tea	<i>Ledum palustre</i>
Willow	<i>Salix sp.</i>
Bistort	<i>Polygonum bistorta</i>
Bur reed	<i>Sparganium sp.</i>
Bog cranberry	<i>Oxycoccus microcarpus</i>
Mare's tail	<i>Hippuris vulgaris</i>
Marsh marigold	<i>Caltha palustris</i>
Pond weed	<i>Potamogeton sp.</i>
Wild flag	<i>Iris setosa</i>
Beach rye grass	<i>Elymus arenarius</i>
Marsh arrowgrass	<i>Triglochin palustris</i>
Oat grass	<i>Hordeum brachyantherum</i>
Rush	<i>Luzula Wahlenbergii</i>
Sedge	<i>Carex pluriflora</i>
Spear rye grass	<i>Poa eminens</i>

Source: AEIDC 1976

Within the wet tundra community, a dwarf shrub meadow often occurs along ponds and streams. Bogs, or areas of impeded drainage, are dominated by sedges and a thick mat of *Sphagnum* moss with cottongrass, dwarf shrubs, heaths, grasses and forbs.

The coastal plain and major river deltas are nearly level with many meandering streams and shallow lakes. Cold, wet organic soils occupy shallow depressions and the tundra vegetation is dominated by sedge tussocks, mosses, and low shrubs (USDI 1979).

The wetland complex associated with Nelson Lagoon encompasses a coastal lowland which is dotted by numerous small lakes and drained by several river systems. This wetland community extends inland to the lower slopes of the Aleutian Range. Wet sedge meadows and grassy meadows cover coastal areas and continue inland along the Caribou-Sapsuk River drainage (Gill et al. 1981). Within this area, inland areas support dwarf shrub meadows and shrub thickets, especially around Herendeen Bay and Port Moller, Deer Island, and south of Nelson Lagoon.

Tideflats - 111-112

Tideflats within the Aleutians East CRSA have been segregated into three categories based on productivity (Hayes et al. 1980): (1) exposed tideflats with low biomass; (2) exposed tideflats with moderate biomass; and (3) sheltered tideflats. Productivity of tideflats is related to the stability of the accumulated sediments which form the basis of a detritus food chain. Exposed tideflats with low biomass are found in high energy areas such as along the mouth of Nelson Lagoon. Exposed tideflats with moderate biomass are found in more protected areas where sediments can accumulate; these areas generally occur in the bays and lagoons along the coastline. Sheltered tideflats develop in protected bays with the unvegetated intertidal area often grading into saline marshes.

Along the north shoreline of the Peninsula abutting the Bering Sea, King et al. (1981) estimated the presence of more than 200 square miles of tideflats (unvegetated intertidal areas) and 16 square miles of brackish wet sedge/grass meadow (vegetated intertidal to the driftwood line) directly affected by tidal influence. The Nelson Lagoon complex encompasses the most extensive mud and sand tidal flats in the region with approximately 89 square miles exposed at mean low tide (Gill et al. 1981). Protected estuarine tideflats and salt marshes cover large areas in Bechevin Bay, Izembek Lagoon, Applegate Cove, Moffet Lagoon, Nelson Lagoon, Herendeen Bay, and Port Moller. These areas are extremely important to the maintenance of the high biological productivity of Bristol Bay. During May and September, tideflats and wetlands of the Aleutians East CRSA are utilized by large numbers of ducks, geese, and shorebirds with waterfowl favoring those areas which support eelgrass beds (Gusey 1979).

Along the southern coastline of the Peninsula fronting the Gulf of Alaska, coastal wetland communities are not as extensive due to the topography and elevation of the shoreline. Within this area, the largest expanses of wetland communities are located at the head of Stepovak Bay and Pavlof Bay.

## **ROCKY ISLANDS AND SEACLIFFS**

Rocky Islands and seacliffs include marine islands of volcanic or tectonic origin with rocky shores and steep faces, offshore rocks and capes, and steep, rocky seafronts with a very limited or absent intertidal area. Seacliffs on the larger islands and the Peninsula mainland have been identified from the Alaska Intertidal Atlas (Sears and Zimmerman 1977) and USGS topographic maps with elevation contours.

Rocky islands and seacliffs dominate the coastal habitat of the southern shoreline of the Peninsula. These islands include unnamed reefs as well as larger islands such as Sanak, Deer, Dolgoi, Unga, Popof, Nagai, and Big and Little Koniugi. The islands occur singly and in groups, extending up to 65 miles from the coast. Most prominent among the island groups are the Sanak Islands, the Sandman Reefs, the Pavlof Islands, and the Shumagin Islands. Amak Island and adjacent rocks located eleven miles northwest of Izembek Lagoon provide the only rocky island habitat along the north shore of the Alaska Peninsula in the Aleutians East CRSA.

Sandman Reefs, 30 miles south of Cold Bay near the tip of the Alaska Peninsula, includes more than 100 small islands and rocky outcrops distributed over an area of approximately 850 square miles. The mean tidal range in this

area is 4.4 feet and the islands receive more precipitation and have more moderate temperatures than Cold Bay due to the Gulf of Alaska maritime influence. Most of the islands are less than 100 feet high and are dominated by upland tundra vegetation and bare rock. Bailey and Faust (1980) noted little diversity in vegetation due to the small size of the islands.

The Shumagin Islands include thirty named islands covering an area 45 by 55 miles (2,475 square miles) with a combined land area of 72 square miles. The mean tidal range in the Shumagins is 5.5 feet with moderate tide rips around the tips of the islands and in narrow passes. The climate of the Shumagins is similar to that of the southern Alaska Peninsula; the mountainous peaks of the Peninsula function as a barrier to moist air from the Bering Sea, resulting in a greater proportion of clear days than other areas in the region. Bailey (1978) reported stands of alder at lower elevations on the larger islands and crowberry dominating the groundcover at higher elevations. Except for a few introduced Sitka spruce, trees are not indigenous to the Shumagins.

Rocky islands and seacliffs of the Aleutians East CRSA provide nesting areas for an abundant populations of seabirds and other avian species, and a disturbance-free haven for marine mammals.

## **EXPOSED HIGH ENERGY COASTS**

Exposed high energy coasts are defined as unprotected areas of coastline directly exposed to ocean-generated waves and storm surges. These habitats are subject to dynamic shoreline processes such as erosion and deposition. Shorelines of high energy coasts are characterized by coarse sand, gravel, boulder beaches, and well-mixed coastal waters. The coastline of the Aleutians East CRSA was mapped to delineate exposed high energy coasts using Michel et al. (1982) and the Alaska Intertidal Survey Atlas (Sears and Zimmerman 1977). Exposed rocky headlands and the seaward beaches of barrier island systems were included as areas of high wave energy, consistent with the ACMP definition for exposed coasts (Map A).

Batten and Murray (1982) characterized the coastline as either wave-cut platforms bordered by low sea cliffs or fjords bordered by cliffs up to 2,000 feet high. The coastal waters are clear and cold with rocky bottoms, surging waves, and strong currents; these conditions provide an ideal habitat for the growth of seaweeds. *Alaria* sp. is a common subtidal seaweed along high energy coasts with *Fucus* sp. dominating the intertidal zone and *Ulva* sp. more common in quiet waters with less rocky or muddy bottoms.

The rocky, exposed coasts of the Aleutians East shoreline are important habitats for marine mammals. Cape Seniavin is used during late winter and early spring by up to 15,000 adult male walrus. The boulder beach of Amak Island, north of Izembek Lagoon, has been identified as the southernmost hauling out ground for walrus (ADF&G 1983). Oskeno Point and Cape Sarichef on Unimak Island provide exposed coasts which are important hauling out and breeding areas for walrus. The principal range of the Alaska Peninsula sea otter population encompasses the exposed coastline along the north shore of the Aleutians East CRSA from Cape Mordvinof to Port Moller.

## **RIVERS, STREAMS, AND LAKES**

Rivers, streams, and lakes include freshwater drainages, riverine systems, floodplains, deltas, lakes, and other smaller bodies of water. Adjacent riparian communities and unvegetated floodplains are also considered components of this coastal habitat type. The aquatic system complexes supported by rivers, streams, and lakes provide important habitat for resident and anadromous fish populations and riparian-dependent wildlife. Rivers and streams function as the conduit for freshwater input to estuarine systems and serve as an important link between upland and marine environments. Rivers, streams, and lakes discernible at the 1/500,000 map scale are shown on Map A; however, it should be recognized that numerous smaller streams and lakes present within the Aleutians East CRSA cannot be depicted due to the limitations of mapping scale.

Rivers and streams draining the Bristol Bay lowlands along the northern shore of the Peninsula generally exhibit a moderate gradient. Principal watercourses originating in the higher elevations of the Aleutian Range and draining southward into the Gulf of Alaska are often short and swift, occasionally plunging into the sea over waterfalls (Batten and Murray 1982). Numerous lakes and ponds occur in wetlands drained by the Caribou River and in coastal lowlands adjoining lagoon systems, particularly Izembek Lagoon. Some of the largest lakes within the region include Sandy Lake, Bear Lake, Sapsuk Lake, and Thinpoint Lake. Smaller ponds are dispersed throughout wetlands and areas of impeded drainage. Ponds are present in the Shumagin Islands National Wildlife Refuge but they seldom exceed 100 acres in size (Hughes 1973).

The major rivers of the Peninsula drain to the north into Bristol Bay, the largest sockeye salmon producing area in the world. Within the Aleutians East CRSA, streams emptying into the Nelson Lagoon complex produce the bulk of the sockeye, chinook, and coho salmon runs (NMFS 1980) with drainages into Izembek and Moffet Lagoons also contributing an important segment of the Aleutian East region's salmon production.

Rivers and streams which support populations of anadromous fish also provide important feeding habitat for brown bears which may be encountered along most stream drainages from May through October. Intensive seasonal use feeding areas for brown bears include north-central Unimak Island, the Cold Bay area, and the streams of the coastal lowlands northeast of Izembek Lagoon (USDI 1982).

## **IMPORTANT UPLANDS**

Important upland habitats occur from above the intertidal splash zone of the coastline inland to the boundary of the Aleutians East CRSA. Within this region of the Alaska Peninsula, the diversity of plant communities and associations that comprise the important uplands coastal habitat are limited by the harsh climate and arduous growing conditions. The Arctic Environmental Information and Data Center (1976) segregated the important uplands into three categories: (1) moist tundra; (2) tall shrub communities; and (3) alpine tundra/barren ground. The relatively cool summers combine with terrain and climate to prevent the establishment of forested habitats within the Aleutians East CRSA, except for a limited number of sites where individual trees or small stands of Sitka spruce have been introduced. One of the oldest stands of introduced Sitka spruce in the Aleutians is located at Sand Point in the

Shumagin Islands. These trees were planted in the early 1800's during the Russian occupation.

The predominant vegetation of the uplands in the Aleutian Peninsula is a luxuriant heath community that occupies gentle slopes and undulating terrain at the lower elevations. Low mountains and steeper slopes support lichens, mosses, and low-growing alpine plants. Higher, wind-swept mountains and ridges are barren rock or perennial snow and relict glaciers (AEIDC 1976).

The moist tundra community occurs on the lower slopes of the Aleutian Range, on the rolling terrain of mountain valleys, and along old marine benches as low plateaus. Slight changes in exposure, drainage, or disturbance can cause marked changes in the predominant plants. This vegetation community is characterized by an almost continuous mat of mosses and lichens and tufted hair grass in which other plants are rooted, including a variety of sedges and grasses. Depressions or poorly-drained areas may support cottongrass, and slightly elevated areas may be dominated by dwarf shrubs such as crowberry, dwarf birch, willow, and blueberry (AEIDC 1976). Within the Aleutians East CRSA, a grass/low shrub community generally occupies wetter growing sites than the heath/shrub community (BBCMP 1983). Common plants of the moist tundra community are listed in Table 1-4.

**Table 1-4: Common plants of the coastal moist tundra community**

Common Name	Scientific Name
Crowberry	<i>Empetrum nigrum</i>
Sedge	<i>Carex saxatilis</i>
Hair moss	<i>Dicranum sp.</i>
Reindeer lichen	<i>Cladonia sp.</i>
Arctic willow	<i>Salix arctica</i>
Blueberry	<i>Vaccinium uliginosum</i>
Cranberry	<i>Vaccinium vitis-idaea</i>
Dwarf birch	<i>Betula nana</i>
Aster	<i>Aster sibiricus</i>
Bistort	<i>Polygonum bistorta</i>
Buttercup	<i>Ranunculus Eschscholtzii</i>
Goldthread	<i>Coptis trifolia</i>
Lousewort	<i>Pedicularis Kanei</i>
Monkshood	<i>Aconitum delphinifolium</i>
Violet	<i>Viola spipsila</i>
Bentgrass	<i>Agrostis borealis</i>
Bluejoint reed grass	<i>Calamagrostis canadensis</i>
Cottongrass	<i>Eriophorum angustifolium</i>
Hair grass	<i>Deschampsia caespitosa</i>
Mountain timothy	<i>Phleum commutatum</i>
Wood rush	<i>Luzula parviflora</i>
Sedge	<i>Carex pluriflora</i>

Source: AEIDC 1976

Exposed slopes and ridges and other steep, well-drained locations at higher elevations support an alpine tundra community that is comparatively arid due to the drying effect of the wind and the shallow soils found on ridges, steep slopes, and mountaintops. Pioneer plants that invade barren areas include lichens, lupine, aster, and cinquefoil. In slightly protected areas, alpine azalea, Arctic willow, mountain avens, and moss campion may be present. Bearberry and cranberry can be found on terraced slopes where a decayed mat of moss and low plants has become established.

Barren rock occurs on the steepest slopes and at higher elevations near snowline. West and south of Pavlof Bay in the Mount Emmons/Pavlof Volcano area, the uplands are predominantly barren rock.

The vegetation of the important uplands habitat in the Shumagin Islands has been described by Bailey (1978). Most of the larger islands are covered with tall, dense stands of alder at lower elevations. Pacific red elder, willows, and salmonberry also commonly occur with the alders. Alder growth is sparse or absent on the outermost islands (Bird, Chernabura, Simeonof, and Little Koniuji) which appear to receive less precipitation than the islands to the north which are closer to the Alaska Peninsula.

Above elevations of 1,000 feet, the important uplands of the Shumagin Islands are dominated by crowberry. Blueberry, lingonberry, and bearberry are also common shrubs in mountainous parts of most of the islands. In meadow areas, on some slopes, and on the small rocky islands devoid of shrubs, grasses and sedges are the dominant vegetative cover. Cow parsnip, hemlock parsley, beach lovage, and *Angelica lucida* are abundant in open grassy slopes (Bailey 1978).

The important uplands of the Aleutians East CRSA provide feeding, nesting, breeding, and migratory habitats for terrestrial birds and mammals of the area. The most conspicuous mammal inhabitants of the important uplands are caribou and brown bear. Domestic cattle have been introduced on Sanak, Chernabura, Simeonof, and Wosnesenski Islands, and bison are present as an introduced species on Popof Island. Historically, fur farming activities have provided an avenue for the introduction of foxes to remote areas where they did not occur naturally.

---

## **CHAPTER 2**

# **Geology and Natural Hazards**

---

### **GEOLOGY**

The continental land mass of the Bristol Bay region, which includes the Bering Sea Shelf and extends south to the Aleutian Trench, was created by continental drift. During the past 200 million years, successive segments of the earth's crust have drifted and adhered to North America, forming the Alaska Peninsula into a continental appendage. The foundational rocks of the Alaska Peninsula are obscured, but ancient limestone deposits in the northern part of the Becharof National Wildlife Refuge to the east of the Aleutians East CRSA indicate that the basement materials are continental crust, formerly attached to the continent about 160 million years ago. During that period, granite was intruded in a curving pattern from the Alaska Range through Becharof Lake and probably offshore to the Pribilof Islands. Sediments derived from the eroded granite comprise feldspar-rich sandstones and coal beds.

Shales are evidence of further sedimentation in an environment unaffected by continental drift. Approximately 60 million years ago, the initiation of volcanic development indicated the beginning of northward movement of the Pacific Plate. The tertiary sediments with carbonaceous layers subsequently formed are most abundant on the north side of the Peninsula (southern Bering Sea) and offshore from the Alaskan mainland. With northward and downward movement of the Pacific Plate along the Aleutian Trench about 10 million years ago, massive outpourings of volcanic rock formed the beginnings of the present day Aleutian Range (BBCMP 1983).

The Shumagin Islands off the south coast of the Alaska Peninsula are characteristic of the offshore islands in this area of the Aleutians East CRSA. The geologic structure of the Shumagins is comprised of deformed strata from the continental shelf between faults which have caused rock units to move up and outward from the Peninsula. Popof Island is volcanic in origin; however, it lacks the rugged mountains and volcanic peaks which characterize the Peninsula mainland.

Rock of volcanic origin dominates the lower Alaska Peninsula. Glacial deposits, including moraines and associated outwash materials occupy the coastal lowlands of the Peninsula and Unimak Island. Volcanic deposits mantle most surfaces except for the steepest mountain slopes. The soils derived from the ash are cindery in areas adjacent to volcanic cones, but have a sandy or silty texture on most lower slopes (AEIDC 1976).

On the slopes of active volcanoes, well-drained cindery soils support sparse vegetation. Large expanses of these soils extend to the coast in many areas, most notably in northern Unimak Island. Ash soils with loamy textures are found extensively throughout the region in areas of lower elevation. The loamy soils are generally well-drained and have a high organic matter content. Depressions on the coastal lowlands and some lower slopes are occupied by peat soils. Permafrost does not occur in the Aleutians East region.

The erodibility of the soils in the region is related to slope of the land surface and texture of the soil. Cindery soils generally have low potential for erosion, even on steep slopes. Erodibility of loamy soils is low on the coastal plains but moderate to high where this soil type occurs on slopes. Soil slips are common on steep slopes throughout the region. High winds which occur throughout the year cause erosional damage on exposed sites, particularly coastal dunes (AEIDC 1976).

The geography of the Aleutians East CRSA land masses and continental shelf waters reflects a combination of both active tectonic processes (forces which alter the structure of the earth's crust) and depositional processes. The Alaska Peninsula consists of coastal lowlands adjoining the Bristol Bay side and the Aleutian Mountains along the Gulf of Alaska coast. The peaks of the Aleutian Mountains generally average 1,000 to 4,000 feet in elevation, but occasionally rise to volcanic peaks such as Mount Veniaminof (east of the Aleutians East CRSA), Mount Pavlof west of Pavlof Bay, and Shishaldin Volcano and Isanotski Peaks on Unimak Island. Unimak Island is separated from the Alaska Peninsula by the narrow but treacherous waters of False Pass. Unimak Pass west of Unimak Island is a strait 10 to 20 miles wide between the Pacific Ocean and the Bering Sea.

The profile of the undersea continental shelf in waters adjacent to the Aleutians East region and the coastal habitat characteristics of the Alaska Peninsula and offshore island groups in the Gulf of Alaska are described in Chapter 1.

## **NATURAL HAZARDS**

Natural hazards which occur within the Aleutians East Area include coastal storm surge flooding, tsunamis, avalanche areas, volcanos, and earthquakes. Events associated with seismic activity are potentially the most damaging natural hazards in the region.

### **Storm Waves**

Climate-related natural hazards in the Aleutians East CRSA area include storm waves, the occurrence of shorefast ice, or the presence of pack ice during winter. Ice conditions are discussed in Chapter 1. Hazardous wave conditions, defined as offshore wave heights in excess of 3.5 meters, are most likely to occur during winter (February) and fall (November) with the greatest percent occurrence of hazardous waves west of Unimak Island and south of Sanak Island and the Shumagin Islands. Maximum observed wave heights range from 7 to 9 meters with the highest waves noted during November (Science Applications, Inc. 1981).

### **Potential Avalanche Areas**

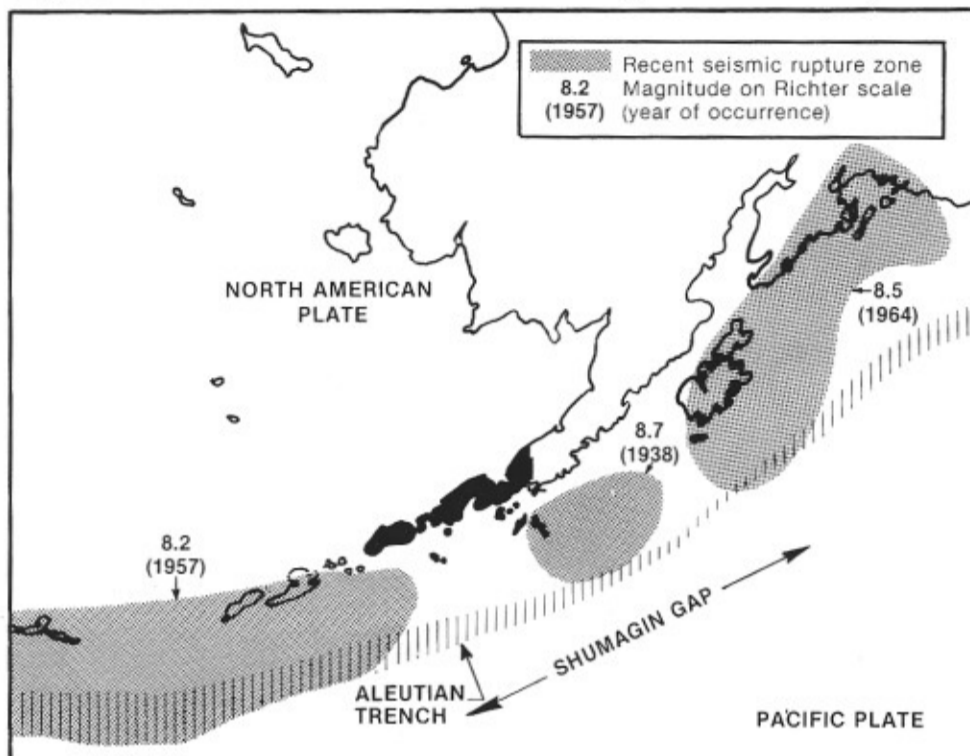
Areas of the Aleutians East CRSA subject to potential avalanche hazards have been interpreted by the Alaska Department of Natural Resources and are shown on Map B. The presence of avalanche zones is dependent upon snow accumulation and steep slopes. These conditions are present in the higher mountainous areas of the region, particularly peaks associated with active and inactive volcanos. In general, areas subject to avalanche activity

are not in close proximity to communities and areas of development in the Aleutians East CRSA.

## Volcanos

The chain of active volcanos along the Aleutian Island/Alaska Peninsula Arc is the result of the advance and downward movement of the Pacific Plate along the Aleutian Trench (Figure 2-1). Increased temperature and pressure result in magma (molten rock) being generated from the descending plate at a depth of about 100 kilometers. A volcano is formed when this molten rock is forced to the earth's surface.

**Figure 2-1: Aleutian Trench and Shumagin Seismic Gap**



Source: Science Applications, Inc. 1981

The Alaska Peninsula and Aleutian Islands chain comprise an area of considerable volcanic and tectonic activity and include sites of historic eruptions and active volcanos. Eleven active volcanos are present within or adjacent to the Aleutians East CRSA; six of these active volcanos are present on Unimak Island. Davies and Jacob (1981) have rated Pogromni, Westdahl, and Shishaldin on Unimak Island, and Pavlof on the Alaska Peninsula as having a high potential for eruption. Active and inactive volcanos, calderas, faults, and thermal spring areas are shown on Map B.

Since 1775, there have been 74 volcanic eruptions (excluding Katmai National Park) on the Alaska Peninsula and Unimak Island. In recent years, the most active volcanos in this region have been Pavlof Volcano located between Pavlof Bay and Cold Bay, and Shishaldin Volcano on Unimak Island (BBCMP 1983). The most recent eruption of Pavlof Volcano occurred in November 1983, the sixth time it has erupted in the last ten years. Mount Veniaminof, adjacent to the east boundary of the Aleutians East CRSA, erupted in October 1983.

The potentially hazardous phenomena associated with volcanic eruptions are directed blasts, pyroclastic flows (rock material fragmented by volcanic action), ash fall, lava flow, and mudslides. Destruction of property and loss of life can occur from shock waves, fire, inundation, and burial. Equipment and machinery, especially aircraft engines, power-generating turbines, and sensitive electronics components may be damaged by highly abrasive ash. The ascending ash cloud and its associated lightning activity may also interrupt radio communications.

In general, immediate effects of a major eruption would probably be confined to a radius of 15 miles or less from the volcano. Two notable exceptions to this situation could be the distances traveled by mudflows and ash falls. The distance mudflows can travel is determined by their volume and the channel gradient. It is possible that mudflows could present a potential hazard to land facilities on the Alaska Peninsula. The dispersal of ash fall is dependent on the prevailing winds and the altitude to which the ash is ejected (Science Applications, Inc. 1981).

In examining the prevailing wind direction in the Aleutians East CRSA, Davies and Jacob (1981) inferred that areas most likely to suffer the effects of ash fall from a volcanic eruption are the north shores of the Alaska Peninsula and Aleutian Islands.

The 1978 eruption of Westdahl deposited one meter of ash on the U.S. Coast Guard light station at Scotch Cap, damaging the facility and forcing evacuation of the site; meltwater floods subsequently washed out the road to Cape Sarichef (Davies and Jacob 1981).

In the vicinity of Ikatan or Morzhovoi Bay, moderate ash fall is possible from an eruption of Shishaldin volcano on Unimak Island. The community of Cold Bay could be affected by ash fall from eruptions of Shishaldin or Pavlof volcanos. In the vicinity of Pavlof Bay, heavy ash fall is possible in the event of a major eruption of Pavlof Volcano (Davies and Jacob 1981).

## **Earthquakes**

Since tectonic activity is extremely high along the Alaska Peninsula and Aleutian Islands, earthquakes are a relatively common phenomenon in the Aleutians East CRSA. This area has produced some of the largest earthquakes on record; however, damage and loss of life have generally been minimal due to the sparse population and lack of development in most parts of the region.

The Aleutian Trench, one of the most active seismic belts in the world, parallels the south side of the Alaska Peninsula and Aleutian chain offshore in the northern Gulf of Alaska (Figure 2-1). The Aleutians East offshore area south of the Peninsula is traversed by the Aleutian Trench, placing the region within a major seismic zone where structural damage caused by earthquakes can be great. Earthquakes of Richter magnitude 6.0 or greater have been recorded for this area and can be expected to occur in the future (BBCMP 1983).

The earthquake-generating processes along the Aleutian Island/Alaska Peninsula Arc are fairly well understood. Earthquakes are generated as the

northwest-drifting Pacific Plate converges with and descends beneath the relatively stationary North American Plate. An earthquake is produced as this convergence is accommodated by the faulting of strata at shallow depths and slippage between the two plates at relatively deeper depths. Deformation at shallow depths generates large earthquakes which can threaten life and property. In the vicinity of the Aleutians East CRSA, most earthquakes larger than Richter magnitude 6.0 have occurred at depths shallower than 60 kilometers (Science Applications, Inc. 1981).

One method of predicting the rate of occurrence of large earthquakes along major plate boundaries involves the identification of "seismic gaps" where large earthquakes have not recently occurred, although their anticipated recurrence period has been equalled or exceeded. The area along the Alaska Peninsula between the Shumagin Islands and southwest tip of Kodiak Island has been identified as a seismic gap (Figure 2-1). The Shumagin Gap seismic area has not ruptured during a great earthquake for nearly 80 years; in this area, the estimated recurrence interval for great earthquakes is 50 to 90 years. A high probability exists for a great earthquake to occur in this region during the next one to two decades (Davies et al. 1981).

Intensive monitoring of earthquake activity and tilting of the earth's crust in this area has indicated deep slippage of the ocean floor, increasing stress and increasing the likelihood of a great earthquake (magnitude greater than 7.75). The last large earthquake in this region was of magnitude 8.7 and occurred in 1939. Annual survey lines across the Shumagin Islands have shown tilting of the land toward the Pacific Ocean, presumably caused by the drag of the descending Pacific Plate. From 1978 to 1980, the tilt reversed; this action has been interpreted as evidence for almost three feet of slippage at great depths. Since there has been no indication of stress relief from earthquakes at shallower depths, researchers are concerned that a major earthquake may be imminent (BBCMP 1983; Science Applications, Inc. 1981).

Some of the potential hazards from earthquakes include destruction or weakening of structures by ground shaking, inundation of areas of subsidence, rupturing of pipelines and storage tanks, and damage from consequent tsunamis. If a major earthquake occurred in the Shumagin or nearby Unalaska Seismic gap, strong ground motion could occur in the Aleutians East CRSA.

### **Flood Hazard Zones**

Flooding of coastal areas within the Aleutians East CRSA could be initiated by wind and tide-driven storm surges or tsunamis generated by undersea seismic activity. General areas of the coastline interpreted by the Alaska Department of Natural Resources as susceptible to these flooding hazards are shown on Map B. Because of the high potential for an earthquake of magnitude 7.75 or greater in the vicinity of the Shumagin gap, there is a possibility of very strong ground motion and tsunami heights (earthquake-generated ocean waves) of approximately 30 meters (BBCMP 1983). In the vicinity of Ikatan or Morzhovoi Bay, a large tsunami of 10 to 30 meters in height could occur. Ikatan Bay would be more sheltered from an Unalaska gap event and more exposed to a Shumagin gap event; the opposite conditions would prevail for Morzhovoi Bay. Cold Bay may be somewhat sheltered from a tsunami generated by rupture of the Shumagin gap, depending on the exact location of the seismic event. Rupture of the Shumagin Gap could also generate a large tsunami in the vicinity of Pavlof Bay; however, the presence of the Pavlof Islands at the entrance to Pavlof Bay may moderate the tsunami height within the Bay (Davies and Jacob 1981).

In the past, earthquakes in this vicinity have generated tsunamis that caused severe damage and loss of life as far as Hawaii and California. In 1946, an earthquake on Unimak Island toppled Scotch Cap lighthouse with a wave of nearly 100 feet in height. In 1957, this same location was subjected to a tsunami wave of 45 feet (Science Applications, Inc. 1981).

Coastal communities within the Aleutians East CRSA that could be affected by tsunamis have been rated as to the potential for impacts from this occurrence by the Alaska Tsunami Warning Center (1982). Cold Bay, False Pass, King Cove, and Sand Point all have a "Local Tsunami Hazard," i.e. a tsunami could be generated in nearby waters and reach the community before a warning could be issued. Historically, these tsunami waves have been high; up to 100 feet or more. Coastal residents experiencing a very strong earthquake, particularly one which lasts more than 30 seconds, should immediately move to higher terrain.

Coastal communities are also subject to "Distant Source Tsunami Hazard," meaning the tsunami is generated so far away that the initiating earthquake is felt only slightly or not at all. Cold Bay and False Pass have been rated as moderate hazards to distant source tsunamis, generally indicating a wave up to 35 feet in height could reach up to three-quarters of a mile inland. King Cove and Sand Point have been rated as high hazard areas with waves of 50 feet in height potentially traveling up to one mile inland. Nelson Lagoon was not rated on the 1982 listing of Distant Source Tsunami Hazards in Alaska.

### **Seismic Risk Areas**

Potential development activities within and adjacent to the Aleutians East CRSA could be subject to hazards associated with earthquakes and volcanic activity in the region. Since certain areas or zones may have a higher probability of seismic activity, these zones should be recognized when considering potential development activities.

In evaluating the seismic and volcanic risks present in the St. George and North Aleutian Basins, Davies and Jacob (1981) provided insight to the probability and magnitude of seismic events in these regions. In the St. George Basin, larger seismic events are likely to occur along growth faults; the maximum magnitude expected is about 8.0. The probability of volcanic activity in the Pribilofs is very low, although the possibility of recent submarine eruptions exists.

Along the Aleutians Arc from Unimak Island to Pavlof Bay, the areas of principal concern are the Shumagin Gap and the possible presence of an Unalaska Gap. These regions have the potential to produce a very great earthquake (magnitude 8.7 or greater) or a series of very large earthquakes (magnitude 7.8 or greater). The risk is the greatest on the south side of the arc where there is a possibility of very strong ground motion and local tsunamis. Due to its proximity to these south Peninsula seismic areas, the southernmost portion of the St. George Basin has a higher risk than that estimated for the Basin as a whole.

---

## **CHAPTER 3**

### **Oil, Gas, and Minerals**

---

#### **MINERAL POTENTIAL**

The Aleutians East CRSA is considered a highly prospective region for the occurrence of mineral deposits (Aksell, Aleut Corp., personal communication). Factors which could enhance development of mineral resources include a climate which does not present extreme seasonal fluctuations, the absence of permafrost, and the relative proximity of tidewater areas for transportation. Development will also be affected by factors such as the size of the deposit or reserve, mineral rights ownership, access, physical limitations to development, availability of transportation facilities, processing requirements, and the economics of development in the current world market.

Much of the Aleutians East CRSA is comprised of strings of long dead volcanos in older island arc settings. Modern arc trends are superimposed on older ones on the Alaska Peninsula. Such geologic formations in other geographic locations have been associated with mineral deposits of economic importance. Types of mineralization that can occur in typical island arc systems include porphyry copper/molybdenum deposits, massive sulfide deposits, and vein and fracture-hosted gold-silver deposits (Resource Associates of Alaska, Inc. 1984). Intrusive rocks found in the Aleutians East CRSA include alkalic granitic and intermediate granitic deposits (granodiorite and quartz diorite) which are potentially favorable for copper, gold, molybdenum, tin, tungsten, zinc, uranium, and/or rare earth metals (ADNR 1982). Identified sedimentary terranes include coal-bearing sandstone and shale, continental sandstone, shale, and conglomerate favorable for deposits of coal and uranium with vanadium as a by-product.

The known mineral occurrences in the Aleutians East CRSA are the result of a very limited history of mineral exploration, and it is possible that the best mineral deposits have yet to be discovered. Because of the limited information available on the mineral resources of the Aleutians East CRSA, the presence of potential mineral deposits is best indicated by the occurrence of favorable mineral terranes. A mineral terrane is an area or surface over which a particular rock or group of rocks is prevalent and which could contain certain mineral deposits. Areas of high mineral potential, specific mineral terranes, and known mineral prospects and occurrences in the Aleutians East CRSA are shown on Map C. While much of the Aleutians East has high mineral potential, it may or may not contain developable mines. Usually only a very small proportion (less than 1 percent) of the land surface within a mineralized area will overlie mineral deposits that can be economically extracted.

#### **Precious Metals**

Unga and Pagan Islands

Unga and Popof Islands have been identified as being highly prospective for gold-silver deposits. Three geologic terranes have been recognized on the two islands. Two of the terranes, Apollo and Caldera, host many known and possibly additional yet-to-be discovered precious metal deposits and occurrences. The third terrane, call the Outlying Terrane, has no known mineralization (Resource Associates of Alaska, Inc. 1984).

The Apollo Terrane, which is composed predominately of volcanic rocks, is cut by a series of northeast trending crustal fractures typical of volcanic arc environments. The crustal breaks are a main controlling feature for the localization of gold dominant precious metal-bearing quartz vein prospects. Twenty-eight known prospects and mines are scattered evenly throughout the terrane (Map C).

The Caldera terrane of northern Unga Island is a rough oval-shaped feature dominated by an andesite ring intrusion-dome complex, a quartz diorite intrusion, a series of northwest trending normal faults, and ring-fracture tectonics. Eight silver dominant precious metal prospects have been discovered to date in the Caldera terrane (Resource Associates of Alaska, Inc. 1984).

### **Alaska Peninsula**

There has been much less mineral exploration on the Alaska Peninsula than on Unga and Popof Islands, yet many mineral prospects, occurrences, and large prospective areas have been determined. There are three generalized terranes in this area (Map C). Volcanic-Plutonic and Jurassic-Cretaceous Sedimentary terranes are both highly prospective for precious metals deposits, while the Bristol Bay Lowlands have not been explored due to lack of bedrock exposure (Resource Associates of Alaska, Inc. 1984).

Numerous known precious metal prospects and geochemical anomalies dot the Volcanic-Plutonic terrane. Examples of known prospects and prospective areas include Canoe Bay (gold), Walrus Peak (lead, zinc, silver), and San Diego Bay (copper, lead, zinc). The Jurassic-Cretaceous Sedimentary terrane has not been adequately explored. An example of vein and replacement mineralization hosted by this terrane is Mud Bay prospect where silver-lead-zinc mineralization is contained in sandstones and calcareous siltstones.

### **Unimak Island**

There has been no geologic exploration on Unimak Island; however it is part of the Tertiary-Recent Volcanic-Plutonic terrane of the Aleutian Island arc system and can be expected to contain mineral prospects.

### **Coal**

During the late 1800's, the U.S. Geological Survey (Walcott 1896) made preliminary assessments of exposed coal deposits at Cold Bay, Herendeen Bay, Unga Island, and Popof Island. Except for the deposit at Herendeen, the coal deposits investigated were either of poor quality or limited by seam thickness. A significant bituminous coal deposit with seams up to 30 feet thick occurs in the Herendeen Bay area. The area also contains strongly anomalous stream sediments with up to 1000 ppm copper, 1500 ppm lead, and 30 ppm silver which is indicative of porphyry copper mineralization. These sediments are similar to those found at Pyramid Mountain.

## MINING ACTIVITIES

Within the Aleutians East CRSA, there is currently a single area of State of Alaska mining claims between Herendeen Bay and Port Moller. A fairly large area is encompassed by a State of Alaska coal prospecting permit application for the area between Herendeen Bay and Port Moller, west of Herendeen Bay, and northeast of Canoe Bay. Resource Associates of Alaska, Inc., Teton, and Freeport Mining Co. are currently exploring Aleut Corporation lands on the Alaska Peninsula and Shumagin Islands for precious metals.

The Apollo and Sitka lode systems on Unga Island are a joint venture that currently comprise the most westerly gold mine in North America. The Apollo and Sitka veins were discovered in 1884 by George C. King and mined from 1894 until 1906. Approximately 500,000 tons of ore averaging 0.22 ounces of gold per ton produced \$3 million for Alaska Commercial Company. In 1908, the main vein of the Apollo Mine was lost at the face of a fault and the mine was closed. A cyanide plant was built in 1915 in an attempt to rework the tailings, but the operation was interrupted by World War I and never reestablished. No activity other than a stock offering followed an announcement in 1916 that the lost vein had been located. A small-scale operation continued until the 1930's when the mine was sold (Morgan 1980). The current owner of the property is Alaska Apollo Gold Mines Ltd., formerly Catalina Energy and Resources, Ltd., headquartered in Vancouver, British Columbia.

During the winter of 1981-82, the Sitka Mine was dewatered to the 250-foot level and the Apollo No. 1 shaft was dewatered to the 450-foot level. With the shafts dewatered and several levels cleaned out, an intensive program of geological mapping and sampling was undertaken to substantiate an inferred reserve estimate of 2.2 million tons of ore. Preliminary underground drilling results from the 150-foot level of the Sitka Mine indicate metal values on the order of 0.03 to 0.66 ounces of gold per ton over vein widths ranging from 2.0 to 3.5 feet. Copper concentrations of 2.3 to 4.5 percent, lead concentrations of 5.9 to 35.6 percent, and zinc concentrations of about 9 percent have also been reported. Silver values in the range of 0.5 to 8.6 ounces per ton were obtained from assays of drill cores (Eakins et al. 1982).

During 1983 exploratory drilling, the presence of a major ore zone of significant tonnage was identified by Alaska Apollo Gold Mines Ltd. following drilling along the strike of the ore vein. It appears that highest precious metal values for gold and silver are found at shallower depths above sea level. The company is optimistic that re-activation of gold mining on Unga Island could be realized in the not-too-distant future (Alaska Construction and Oil, December 1983).

Long-range plans under consideration for the Apollo and Sitka mines include a potential road link between Delarof Bay and deep water on Baralof Bay, conversion of a beached tanker to a processing facility, local power generation with Unga coal, and construction of a runway at the head of Baralof Bay (Kent 1980).

Preliminary data indicate that the Pyramid Mountain copper prospect on

Native lands north of Balboa Bay shows potential for future development, but not within the next 20 years (BBCMP 1983). Pyramid is the site of a porphyry copper-molybdenum deposit with reserves of 100 million tons of 0.5 percent copper and 0.03 percent molybdenum. In addition, strong stream sediment geochemical anomalies (up to 500 ppm copper, 700 ppm lead, 20 ppm silver, and 70 ppm molybdenum) several miles to the north of the site suggest a similar potential for porphyry copper-molybdenum deposits in that area.

There are currently no large-scale placer mining operations in the Aleutians East region, although drainages which flow from areas of intrusive, mafic, or ultramafic rock and volcanic assemblages are potential locations for future discoveries of economic deposits.

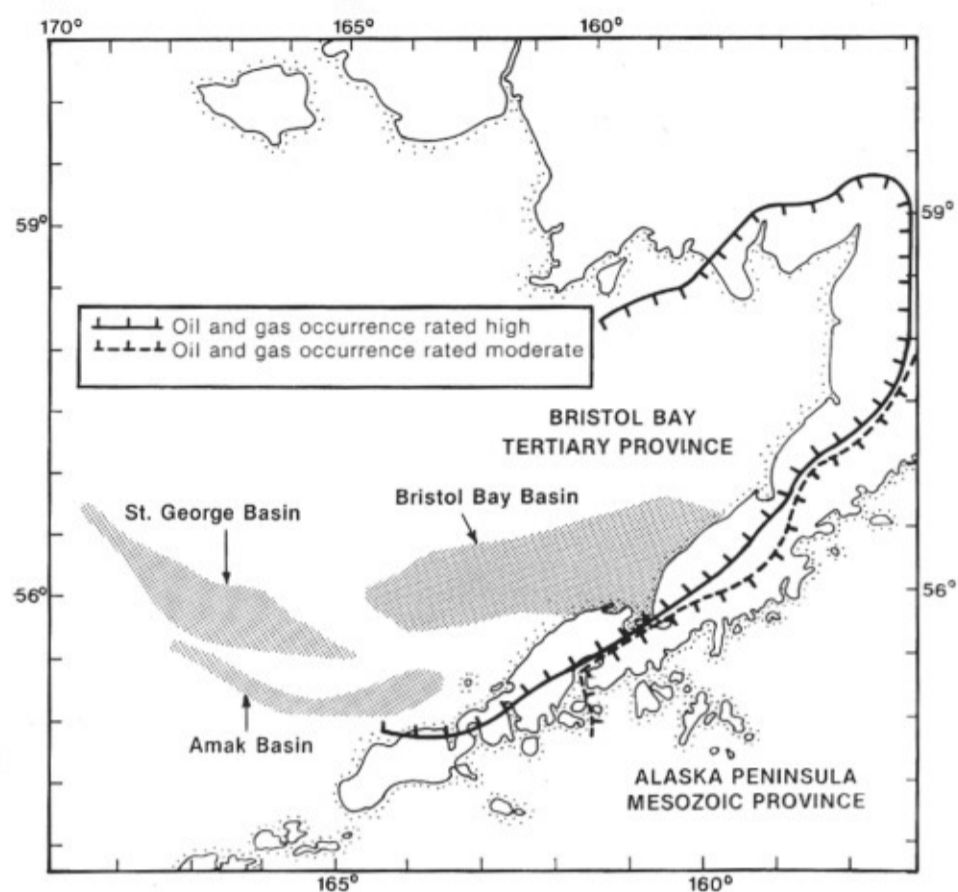
A potential coal field at Herendeen Bay is estimated at somewhat less than 300 million tons of bituminous coal, but the full extent of the field is unknown. The coals present are high-volatile B bituminous with a high ash content. The areal extent of the field extends from Pavlof Bay over 200 miles northeast to Dog Salmon River (Conwell and Triplehorn 1978). In the southern section of the deposit, the coal is primarily of a lignious nature. Beds in this field are up to 2.1 meters thick and moderately folded and faulted. Some small surface mines currently are in intermittent operation (BBCMP 1983). Bituminous coal resources present in the area from Port Moller to Pavlof Bay have been used in the past by residents of the region for space heating.

## **OIL AND GAS POTENTIAL**

Two oil and gas provinces present within the Aleutians East CRSA have potential for exploration and possible discovery and development activities. These provinces are the Bristol Bay Tertiary and the Alaska Peninsula Mesozoic Provinces (Figure 3-1). First indications of oil on the Alaska Peninsula were reported by the Russians as early as 1853 near Kanatak (southern Becharof National Wildlife Refuge). Between 1903 and 1981, twenty-six test wells were drilled at various locations on the Alaska Peninsula with test wells drilled within the Aleutians East area on uplands at Canoe Bay (Pure Oil), Sandy River (Gulf Oil), David River (Amoco Oil), Hoodoo Lake (Amoco Oil), and Cathedral River (Amoco Oil) (Map C). While many of these wells showed the presence of oil and/or natural gas, none of the wells encountered deposits that were economically feasible to produce at the time of exploration. However, this drilling activity did provide stratigraphic information to evaluate the potential for hydrocarbon deposits in the adjacent offshore areas of the north Peninsula (Science Applications, Inc. 1981). Exploratory activity has again increased in upland areas during 1984.

The Alaska Mesozoic Province may contain oil and gas in the marine sedimentary rocks extending along the southern shore of the Alaska Peninsula and the Gulf of Alaska. Some shows of oil and gas in exploratory test wells and the occurrence of surface seeps indicates a potential for hydrocarbon deposits. However, unfavorable geologic conditions such as intense and complex structural deformation and past and present volcanic activity can inhibit or preclude discoveries of commercially recoverable petroleum. It has been speculated that prospects for oil and gas are good where Mesozoic rocks are overlain by Tertiary rocks containing good reservoir sandstone. A geologic setting similar to this condition may be present in the offshore area between Shelikof Strait and Unga Island (BBCMP 1983).

Figure 3-1: Oil and gas onshore and offshore basins



Source: Science Applications, Inc. 1981

Based on a 1976 assessment by the Alaska Department of Natural Resources, Division of Geological and Geophysical Surveys, the potential for hydrocarbon deposits within uplands of the Aleutians East CRSA is shown on Map C. Areas having a high potential for the presence of hydrocarbons exhibit favorable geology and either favorable finds of oil and gas in test wells or ratings in the top 10 percent of potential oil and gas basins in the state-wide assessment. Moderate potential for presence of hydrocarbons is defined as favorable geology with negative results in test wells to date or ratings in the top 10 to 40 percent of potential oil and gas basins in the state-wide assessment (ADNR 1982). The area of highest potential is encompassed by coastal lowlands and tidelands of the north Peninsula from Izembek Lagoon east to Sandy River. Lands of the Bristol Bay area tend to be gas prone, with any deposit discovered about twice as likely to be gas as oil. However, only small quantities of either resource are considered likely to be present (BBCMP 1983).

The oil and gas basins found in upland areas of the Peninsula continue offshore under the State-owned tide and submerged lands and into the federal Outer Continental Shelf (OCS). The Bristol Bay Basin (included in the North Aleutians Shelf OCS lease sale area), Amak, and St. George Basins are

shown in Figure 3-1. The geologic formations which are potential petroleum source rocks in the offshore waters of Bristol Bay occupy a structural depression which began to form about 100 million years ago and has continued to subside ever since. This depression is filled with sedimentary rocks of detritus (organic matter) eroded from mainland and Alaska Peninsula mountain ranges, and volcanic debris from the Alaska Peninsula. These deposits may reach 8 km in thickness in the deepest parts of the depression with deposits in a large portion of the Bristol Bay Basin more than 3 km thick. In the offshore waters, geologic strata considered to have the best potential for petroleum are flat-lying sandstone, siltstone, and shale from 10,000 to 60 million years of age (Science Applications, Inc. 1981).

Available data indicate that the highest potential for discoveries of oil and gas in nearshore and upland areas within the region are in the State-owned tide and submerged lands and adjacent uplands along the north side of the Alaska Peninsula. Estimates of undiscovered potentially recoverable hydrocarbons in the North Aleutian Basin outer continental shelf (Bristol Bay Basin) adjoining the north coast of the Aleutians East area show a 47 percent chance of finding 0.6 billion barrels of oil and 3.9 trillion cubic feet of natural gas. A U.S. Geological Survey estimate of the potential recoverable hydrocarbons in the recent St. George Basin OCS sale area northwest of Unimak Island indicate that 1.1 billion barrels of oil and 3.7 trillion cubic feet of natural gas could be present. Although these estimates are speculative and based on very limited data, they do illustrate the potential for oil and gas discoveries in the OCS area adjacent to the Aleutians East region.

To date, the only recent lease sales in the vicinity of the Aleutians East CRSA have occurred in the St. George Basin northwest of Unimak Island. No lease sales have occurred in the outer continental shelf immediately adjacent to the Aleutians East CRSA. During the 1960's, some competitive oil and gas lease sales were conducted for State offshore areas (submerged lands and tidelands) in the vicinity of Port Moller and Herendeen Bay, and an offshore/uplands lease sale occurred near Pavlof Bay (ADNR 1983).

---

## **CHAPTER 4**

# **Marine Fish and Invertebrates**

---

### **PELAGIC MARINE FISH**

Little is known about the pelagic marine fish that inhabit the waters off the Aleutians East CRSA. The more common species include Pacific herring (*Clupea harengus pallasii*), Pacific sardine (*Sardinops sagax*), surf smelt (*Hypomesus pretiosus*), capelin (*Mallotus villosus*), Pacific saury (*Cololabis saira*), and salmon shark (*Lamna ditropis*). Of these species only herring is of commercial importance. All these species of pelagic marine fish generally live near the sea surface, migrate over long distances, are of small size (except for the salmon shark), often form dense schools, and are important forage for many commercially and ecologically important fishes, birds and marine mammals (Smith 1982).

#### **Pacific Herring**

Pacific herring are found in the waters adjacent to the Aleutians East CRSA both in the Bering Sea and the Gulf of Alaska. Aleutians East CRSA waters appear to be a transition area between Gulf of Alaska stocks and Bering Sea stocks. Herring populations east of Canoe Bay have growth and size characteristics similar to other Gulf of Alaska stocks, and Canoe Bay populations are more similar to Bering Sea herring (Malloy, ADF&G, personal communication).

More is known about the life history of Bering Sea herring than Gulf of Alaska herring. Most data for both stocks, however, has been collected during the spring when herring inhabit near shore waters to spawn. Virtually no information is available concerning herring larval and juvenile life stages and information concerning the distribution and migration patterns of adult herring, except during spawning, is sketchy (BBCMP 1983).

Pacific herring undertake extensive migrations in response to changes in water temperature, salinity, and food availability. In the Bering Sea, the major wintering area is located in 105 to 137 m deep, 2° to 3.5° C water northwest of the Pribilof Islands. A smaller wintering area may also exist north of Unimak Pass (BBCMP 1983). Wintering areas in the Gulf of Alaska are not known.

Herring leave their Bering Sea wintering grounds in late March and migrate to discrete spawning areas along the Southeastern Bering Sea coast. While the primary spawning grounds for Bering Sea herring are in Bristol Bay, there are smaller spawning grounds in the Aleutians East CRSA including Port Moller Bay, Herendeen Bay, and along the north side of Unimak Island. Along the South Peninsula, spawning has been observed in Aleutians East CRSA waters along coastal stretches in or adjacent to Cold Bay, King Cove, Belkofski Bay, the Pavlof Islands, Pavlof Bay, Canoe Bay, Balboa Bay, American Bay and Stepovak Bay (Map D; BBCMP 1983; Malloy, ADF&G, personal communication). Although the precise location of herring spawning areas may vary from year to year, in general it appears they return to the same spawning grounds each year.

Herring spawning in the Alaska Peninsula area can begin in April; however, it generally begins in May. Water temperature may significantly alter spawning times; i.e. in warm years herring spawn early, in cold years they spawn late. Spawning may occur over a period of a few days to several weeks. Older fish are usually first to spawn, followed by younger fish, although this pattern is more evident in some locations than others. Eggs are generally deposited on rockweed *Fucus spp.* or eel grass *Zostera spp.* in intertidal or subtidal waters, although some egg deposition occurs on other marine vegetation, and less frequently on barren gravelly substrate. Males then extrude milt over the eggs. Egg development is closely tied to water temperature; larvae generally hatch in two to three weeks. Herring larvae remain planktonic for 6 to 10 weeks, then metamorphose into juveniles. Juvenile herring form schools and move off-shore as summer progresses; however, their precise movements in Aleutians East CRSA waters are not known (BBCMP 1983; Malloy, ADF&G, personal communication).

Bering Sea herring spawn for the first time at ages three or four, and by age five, 95 percent of the population has matured. Fecundity increases with body size. Hence, Bering Sea herring, which are larger at maturity than Gulf of Alaska herring, produce more eggs than Gulf of Alaska herring (Malloy, ADF&G, personal communication).

Herring may live 15 years or more but fish older than 10 years are uncommon. Most of the commercial catch consists of fish seven years old or less. When a strong year class is recruited into a herring stock, its members will continue to comprise significant portions of the spawning population through their tenth year (BBCMP 1983).

Herring are an important prey species for marine mammals, birds, and groundfish. In addition, a variety of predators including birds and flatfish (especially yellowfin sole) prey on herring eggs.

## GROUND FISH

The marine waters surrounding the Aleutians East CRSA contain abundant groundfish resources. To the north is the Bering Sea with an estimated maximum sustainable yield (MSY) of 1.9 million metric tons (mt) of groundfish species; to the south is the Gulf of Alaska with a total groundfish MSY of 0.62 million mt; and to the west is the Aleutians Island Region with a total groundfish MSY of 0.13 million mt.

In general, the diversity of the groundfish assemblage decreases from south to north, largely as the result of a simplification of the rockfish community. While similar species are found in the waters of the northwest Gulf of Alaska and the southeast Bering Sea, their relative abundance is quite different. Pollock is by far the most abundant species in both areas, but the size of the resource is much greater in the Bering Sea. Pacific cod reaches its greatest level of abundance in the Gulf of Alaska. Yellowfin sole, which is the dominant flounder in the Bering Sea, is scarce in the Gulf of Alaska where arrowtooth flounder is the dominant flounder species (Ronholt et al. 1978).

Differences between species found in Bering Sea and Gulf of Alaska waters adjacent to the Aleutians East CRSA largely reflect bathymetric and environmental differences between the areas. North of the Aleutians East CRSA is the gently sloping, relatively featureless and shallow Bering Sea continental shelf. To the south, the Gulf of Alaska shelf is much narrower, and the continental slope and deep water are relatively close to shore. The Gulf bottom has rugged topography and is traversed by numerous rocky submarine canyons.

Map D illustrates areas of groundfish concentration, documented spawning areas, and important nursery areas.

### Gulf of Alaska

The Gulf of Alaska groundfish species found in the waters adjacent to the Aleutians East CRSA are generally recognized as belonging to a northern Aleutian, cold water zoogeographic province (Smith 1982). Common groundfish species from the area are listed in Table 4-1. Species of particular importance to the commercial fishing industry are walleye pollock, Pacific cod, Pacific Ocean perch, Atka mackerel, Pacific halibut, sablefish, and arrowtooth flounder.

**Table 4-1: Common demersal fishes that occur in the marine waters of the Aleutians East CRSA**

Gulf of Alaska		
Common Name	Scientific Name	Habitat <sup>1</sup>
Sturgeon poacher	<i>Agonus acipenserinus</i>	E, M
Aleutian alligatorfish	<i>Aspidophoroides bartoni</i>	E, M
Sablefish <sup>2</sup>	<i>Anoplopoma fimbria</i>	U
Searcher	<i>Bathymaster signatus</i>	NSD
Spinyhead sculpin	<i>Dasycottus setiger</i>	E, M
Armorhead sculpin	<i>Gymnocanthus galeatus</i>	NSD
Threaded sculpin	<i>Gymnocanthus pistilliger</i>	NSD
Yellow Irish lord	<i>Hemilepidotus jordani</i>	NSD
Bigmouth sculpin	<i>Hemitripterus bolini</i>	NSD
Great sculpin	<i>Myoxocephalus polyacanthocephalus</i>	NSD
Ribbed sculpin	<i>Triglops pingeli</i>	E, M
Giant wrymouth	<i>Delolepis gigantea</i>	NSD
Dwarf wrymouth	<i>Lyconectes aleutensis</i>	E, M
Pacific cod <sup>2</sup>	<i>Gadus macrocephalus</i>	NSD
Pacific tomcod	<i>Microgadus proximus</i>	NSD
Walleye pollock <sup>2</sup>	<i>Theragra chalcogramma</i>	NSD
Whitespotted greenling	<i>Hexagrammos stelleri</i>	NSD
Lingcod	<i>Ophiodon elongatus</i>	E, M
Atka mackerel <sup>2</sup>	<i>Pleurogrammus monopterygius</i>	NSD
Arrowtooth flounder <sup>2</sup>	<i>Atheresthes stomias</i>	E, M
Rex sole	<i>Glyptocephalus zachirus</i>	E, M
Flathead sole	<i>Hippoglossoides elassodon</i>	E, M
Pacific halibut <sup>2</sup>	<i>Hippoglossus stenolepis</i>	E, M, B
Butter sole	<i>Isopsetta isolepis</i>	E, M
Rock sole	<i>Lepidopsetta bilineata</i>	NSD
Yellowfin sole	<i>Limanda aspera</i>	NSD
Dover sole	<i>Microstomus pacificus</i>	E, M
English sole	<i>Parophrys vetulus</i>	E, M
Starry flounder	<i>Platichthys stellatus</i>	E, M
Alaska plaice	<i>Pleuronectes quadrituberculatus</i>	E, M
Skates	<i>Raja</i> spp.	E, M

Rougheye rockfish	<i>Sebastes aleutianus</i>	E, M
Pacific Ocean perch <sup>2</sup>	<i>Sebastes alutus</i>	E, M
Shortraker rockfish	<i>Sebastes borealis</i>	E, M
Northern rockfish	<i>Sebastes polyspinis</i>	E, M
Sharpchin rockfish	<i>Sebastes zocentrus</i>	E, M
Longspine thornyhead	<i>Sebastolobus altivelis</i>	E, M
Shortspine thornyhead	<i>Sebastolobus alascanus</i>	E, M
Longsnout prickleback	<i>Lumpenella longirostris</i>	NSD
Daubed shanny	<i>Lumpenus maculatus</i>	NSD
Snake prickleback	<i>Lumpenus sagitta</i>	NSD
Pacific sandfish	<i>Trichodon trichodon</i>	NSD
Shortfin eelpout	<i>Lycodes brevipes</i>	E, M
Wattled eelpout	<i>Lycodes palearis</i>	E, M

#### Bering Sea

Common Name	Scientific Name	Habitat <sup>1</sup>
Yellowfin sole <sup>2</sup>	<i>Limanda aspera</i>	NSD
Walleye pollock <sup>2</sup>	<i>Theragra chalcogramma</i>	NSD
Pacific cod <sup>2</sup>	<i>Gadus macrocephalus</i>	NSD
Rock sole	<i>Lepidopsetta bilineata</i>	E, M
Alaska plaice	<i>Pleuronectes quadrituberculatus</i>	E, M
Flathead sole	<i>Hippoglossoides elassodon</i>	E, M
Longhead dab	<i>Limanda proboscidea</i>	
Pacific halibut <sup>2</sup>	<i>Hippoglossus stenolepis</i>	E, M, B
Plain sculpin	<i>Myoxocephalus jaok</i>	
	<i>Myoxocephalus sp.</i>	
Starry skate	<i>Raja stellulata</i>	
Yellow Irish lord	<i>Hemilepidotus jordani</i>	NSD
Sturgeon poacher	<i>Podothecus acipenserinus</i>	E, M
Great sculpin	<i>Myoxocephalus polyacanthocephalus</i>	NSD
Starry flounder	<i>Platichthys stellatus</i>	E, M
Arrowtooth flounder <sup>2</sup>	<i>Atheresthes stomias</i>	E, M
Greenland turbot <sup>2</sup>	<i>Reinhardtius hippoglossoides</i>	
Wattled eelpout	<i>Lycodes palearis</i>	E, M
Skate unident.	<i>Raja sp.</i>	E, M
Pacific sandfish	<i>Trichodon trichodon</i>	
Rex sole	<i>Glyptocephalus zachirus</i>	E, M
Whitespotted greenling	<i>Hexagrammos stelleri</i>	NSD

<sup>1</sup>E = epidemersal (on bottom), M = mesodemersal (above bottom), NSD = nearshore shelf demersal, b = bathydemersal (deep water bottom), U = ubiquitous.

<sup>2</sup>Species of major importance to the commercial fishery.

Sources: Bakkala and Sample 1982, Smith 1982

Pollock fecundity varies with the size of the female, with average fecundity being approximately 10,000 eggs. Eggs are pelagic and are found in near surface waters. They hatch in two or three weeks, depending on water temperature, and larvae then float near the surface for an unknown period of time (Morris et al. 1981). As juveniles develop they become more demersal in habit. Young pollock are widely distributed both in the Gulf of Alaska and the Bering Sea. While juveniles overlap the adult range, they also extend into much shallower waters. Recent surveys of South Peninsula waters found particularly high relative densities of one-year-old pollock in Pavlof Bay, Unga Strait, and Stepovak Bay (Smith 1982). Pollock two years old or older remain restricted to deeper waters. Sexual maturity in pollock is related to body size but most reach sexual maturity at three or four years when males are about 32 cm and females are 40 cm long (BBCMP 1983). Pollock are recruited into the commercial fishery beginning at age 3. Although pollock may reach three feet in length, most commercially harvested fish are about 12 inches.

Pollock are important prey and predators in both the Gulf of Alaska and Bering Sea. Their feeding behavior is largely controlled by body size, location, and time of year. They consume both benthic and pelagic organisms including fish, euphausiids, copepods, and amphipods. Pollock are cannibalistic and adults consume significant numbers of juveniles. Pollock are preyed upon by a variety of marine mammals, seabirds, and other groundfish (BBCMP 1983).

#### **PACIFIC COD**

Pacific cod are a widespread demersal species whose populations have significantly increased in both the Gulf of Alaska and the southeastern Bering Sea in recent years. The maximum abundance of adult Pacific cod is generally found at depths less than 100 m.

The migratory habits of Pacific cod are not well known, although they do engage in seasonal movements from deep to shallow water. In the Bering Sea, cod concentrate in the deep waters of the outer continental shelf and slope during the winter and early spring (February to June). As summer approaches they migrate to shallower areas. This geographic movement is not, however, extensive and seems to be a function of cod abundance and, to a lesser degree, water temperature. Movements into inner shelf waters appear to occur only in warm years when populations are high (BBCMP 1983). In the Gulf of Alaska, cod appear to be most abundant in canyons that cut across the shelf and along the shelf edge and upper slope between depths of 100 and 400 m during the winter and spring. By summer, they shift to shallower water depths between 30 and 75 m (Morris et al. 1983).

Pacific cod are thought to spawn during the winter. They are among the most fecund of groundfish; large females are capable of producing over a million eggs. Fertilized eggs are demersal and slightly adhesive, while larvae are pelagic. The incubation period for cod eggs is between 10 and 20 days (Thorsteinson and Thorsteinson 1984). Nursery areas are not precisely known but are thought to be principally in coastal areas with rocky bottoms. A recent survey of the waters south of the Aleutians East CRSA found 4 to 7 month old Pacific cod in inner Pavlof Bay, Wide Bay, and Paule Bay within depth ranges of 18 to 60 m (Smith 1982). In a 1975 late summer survey of the Bering Sea, concentrations of cod less than one year old were encountered in nearshore waters off the Alaska Peninsula near the 40 m depth contour. Age four fish and older are found on the outer shelf and slope (BBCMP 1983).

Cod grow rapidly and have a relatively short life span. While individuals may reach 91.4 cm, most cod taken in the Gulf of Alaska fishery are between 45.7 and 68.6 cm in length. Peak abundance in the fishery is at age three and rarely exceeds age six. Age at maturity is not known but is thought to be between ages four and five. Females first spawn at 55 cm, and about 50 percent reach maturity at 70 to 75 cm. About 50 percent of male cod reach maturity at 69 cm.

Cod are near the top of the foodchain within the demersal animal communities of the southeastern Bering Sea and Gulf of Alaska and feed on a variety of prey, including fish such as herring and sand lance, and invertebrates such as worms, crabs, clams, snails, and shrimp (Morris 1983). Adult Pacific cod in the Bering Sea north of the Aleutians East CRSA appear to prey heavily on three and four year old red king crab (Thorsteinson and Thorsteinson 1984). Few data are available on Pacific cod predators, although large halibut, seals, belukha whales, and sperm whales are all thought to consume adult Pacific cod (BBCMP 1983).

#### **PACIFIC HALIBUT**

Pacific halibut are the largest of all flounders and are widely distributed in both the Gulf of Alaska and the southeastern Bering Sea. Adult halibut have a wide bathymetric range but are most abundant in the Gulf of Alaska at water depths between 25 and 300 m (Morris et al. 1983) and in the Bering Sea between 350 and 500 m (BBCMP 1983).

Pacific halibut in both the Gulf of Alaska and southeastern Bering Sea undertake seasonal migrations. In the Bering Sea, halibut concentrate in 2° to 5° C (350 to 500 m) water of the continental slope during the winter and spring (November through April). As shelf waters begin to warm in April, halibut begin to disperse over these shallower waters, moving northeastward along the Alaska Peninsula. By the end of May most migrating halibut have reached the 55-m isobath; by June most of the southeastern Bering Sea halibut stock is in shallow water (50 to 150 m), and by July the migration is complete (BBCMP 1983). During this summer period, adult halibut are primarily found on the off-shore flats of the Bering Sea shelf, while juvenile one and two year olds use the coastal waters north of the Alaska Peninsula as a nursery area with Slime Bank being especially important (Science Applications, Inc. 1981). Near the end of October, halibut retrace their spring migration path and return to their deeper water wintering grounds. In the Gulf of Alaska, seasonal movements are not as pronounced. Some west to east migrations along the shelf by both juveniles and adults have been observed. In addition, adult halibut undertake migrations from deep water wintering and spawning grounds to shallow water feeding grounds during the summer (Morris et al. 1983).

Spawning occurs while halibut are in deep waters, probably between December and February in the Bering Sea and between November and March in the Gulf of Alaska. While spawning occurs all along the continental shelf edge, the major spawning grounds are located to the east of the Aleutians East CRSA in the Gulf of Alaska, and to the west of the Aleutians East CRSA in the southeastern Bering Sea (St. Pierre, in press). Halibut eggs are slightly buoyant

and rise to about 200 m where they drift with the current. Hatching occurs between 12 and 20 days, depending on water temperature (BBCMP 1983). Larvae drift with the currents for four to six months. During this period, halibut can be transported hundreds of kilometers. Prevailing coastal currents in the Bering Sea carry some larvae northeast along the Alaska Peninsula. Halibut larvae from Gulf of Alaska stocks are carried through passes in the Aleutian chain into the Bering Sea. By late May or June, larval halibut descend to the bottom and metamorphose into bottom-dwelling juveniles in shallow nearshore nursery areas. Important halibut nursery areas adjacent to the Aleutians East CRSA include the shallow Bering Sea waters to the north of the Alaska Peninsula and Unimak Island, Unimak Bight, and the waters off Shumagin Island (Morris et al. 1983). There is evidence that the Bering Sea nursery area is also used by Gulf of Alaska halibut stocks. In addition, approximately 24 percent of five to twelve year old halibut that reared in Bristol Bay waters return to the North Pacific Ocean through Unimak Pass (BBCMP 1983).

Halibut age-at-maturity varies with sex. In the Bering Sea, the age at which 50 percent of halibut are mature is 13.8 years (122cm length) for females; and 7.5 years (72cm length) for males. Females are larger than males with specimens as long as 267 cm (105 in) reported.

Pacific halibut feed year-round with adults feeding less in winter and juveniles feeding more. They are opportunistic feeders that prey on a variety of organisms. Small halibut prey mainly on shrimp and other small crustaceans. Fish, principally flounder, predominate in the diet of older halibut. While some predation on halibut probably occurs, there is little reported evidence. By age five or six, halibut become apex predators, immune from predation except by the larger marine mammals (BBCMP 1983).

#### **YELLOWFIN SOLE**

Yellowfin sole are widely distributed in both the Gulf of Alaska and southeastern Bering Sea; however, commercially important quantities are only found in the Bering Sea. The majority of the Bering Sea's estimated 2.0 million mt biomass of yellowfin sole is confined to shelf waters south of St. Matthew Island, with the center of abundance being in central Bristol Bay, north of the Aleutians East CRSA (BBCMP 1983).

Yellowfin sole engage in complex bathymetric and geographical movements that are not fully understood. These movements are affected by environmental factors such as water temperature and sediment type. Concentrations of yellowfin sole are found where water temperature is between 1° and 9° C and the substrate is sandy-silt (BBCMP 1983). In the winter, yellowfin sole separate by size with young, relatively small fish congregating in outer Bristol Bay at depths between 70 and 100 m. Adults congregate in large dense schools on the outer shelf and upper slope at depths of 90 to 360 m. The largest schools form in the Unimak Island vicinity during February and March. Beginning in April, wintering juvenile and adult fish move into the shallower waters of the shelf. The Unimak Island concentration disperses from Bristol Bay to Kuskokwim Bay, and by June, yellowfin sole extend shoreward of the 100 m contour. Concentrations are regularly found at this time near Amak Island and off Port Moller (BBCMP 1983).

Yellowfin sole appear to spawn from early July through September in water from 15 to 75 m in depth, on sandy substrates, and at water temperatures between 4.4° and 11.4° C. Since spawning areas are discrete, relatively small areas, they are considered important to the maintenance of the population. The fecundity of yellowfin sole increases with size and is greater than most other flatfish in the southeastern Bering Sea. Large females are capable of producing over three million eggs in one season. Yellowfin sole eggs are pelagic. Larvae occupy a small area of the inshore shallows of the Bering Sea continental shelf, including the waters just north of the Aleutians East CRSA (BBCMP 1983). The time between egg hatch and larvae metamorphosis is not known. The distribution of juveniles is poorly known, although they have been observed in low abundance in nearshore waters off the Alaska Peninsula. They subsequently disperse to offshore waters and by ages five to eight occupy the same waters as the adults.

Yellowfin sole are a small, slow-growing species. Most females reach sexual maturity at age nine with an average length of 30 to 32 cm; males reach sexual maturity at age four (16-18 cm). Yellowfin sole can live up to 25 years. They usually enter the commercial fishery at age five or six.

Yellowfin sole are opportunistic feeders whose prey depends on their size, the season, and area. Prey foods range from benthic clams and worms to zooplankton and small pelagic fish. During winter yellowfin sole feeding activity decreases or ceases completely. The major predator of yellowfin sole is the Pacific halibut; other predators include larger fish and marine mammals such as belukha whales and fur seals (BBCMP 1983).

### **SABLEFISH**

Sablefish, or black cod, are a widely distributed species whose range extends from the Baja Peninsula in Mexico to the Bering Sea. Its center of abundance, however, is in the Gulf of Alaska. Stocks in both the Gulf and Bering Sea have been greatly reduced since the early and mid-1970s. Recent Japanese surveys indicate some stock recovery (Sasaki 1981).

Sablefish inhabit the continental slope with the center of abundance for adults situated between depths of 400 and 1000 m. In the Gulf of Alaska, they are concentrated near submarine canyons and gullies, as well as on seamounts.

Tagging studies regarding the migratory behavior of sablefish are inconclusive; however, they do suggest that sablefish throughout the Northeast Pacific form one genetic pool (Balsinger 1982). Sablefish have a tendency to move into deeper water as they grow older. There is also a seasonal bathymetric movement of sablefish to somewhat shallower waters in the spring (Morris et al. 1983).

Sablefish spawn during the fall to spring months at depths of 250 to 750 m. Adults mature at ages 5 to 7. Their eggs are bouyant and rise to the surface where they drift until hatching. Sablefish larvae are planktonic and common in the surface waters of the shelf and in shallow bays and inlets during late spring and early summer (Morris et al. 1983). One-year-old sablefish have been

found in relatively high abundance in the central Alaska Peninsula Region, east of the Aleutians East CRSA. Juveniles return to deeper waters on the outer shelf and slope.

Sablefish are fast-growing fish that can live for 20 years. They generally enter the commercial fishery between ages 3 and 8. Sablefish are omnivorous and feed on semi-pelagic animals such as squid and lanternfish, bottom-dwelling fish, and invertebrates, as well as the remains of other animals.

## ROCKFISH

The term rockfish refers to a large number of fish in the genus *Sebastes* and *Sebastolobus*. Rockfish distribution patterns are poorly known. The number of species decreases from south to north with the Gulf of Alaska supporting more species than the Bering Sea. Rockfish of the genera *Sebastes* are generally concentrated along the upper continental slope, whereas species of *Sebastolobus* are found in deeper water on the continental slope.

Pacific Ocean perch are the major component of the rockfish group and the target of the most intensive commercial fishery. Recently the Japanese longline fishery has focused on *Sebastolobus alascanus*, or the shortspined thornyhead. Both these and other rockfish species are also taken as incidental catches in both longline and trawl fisheries.

Pacific Ocean perch are small (rarely exceeding three pounds in weight) members of the groundfish fauna that were formerly abundant in both the Gulf of Alaska and the Bering Sea. Overfishing has greatly reduced the stocks. They are most abundant in gullies, canyons, and depressions of the upper slope in the Bering Sea. They are found in similar habitats in the Gulf of Alaska with a maximum population abundance east of the Aleutians East CRSA. Pacific Ocean perch undergo seasonal migrations. They move to the shelf edge for feeding from May to September, descending to upper slope waters for spawning in September and November in the Gulf of Alaska (Morris et al. 1983) and September to January in the Bering Sea.

Pacific Ocean perch and other rockfish of the genus *Sebastes* have internal fertilization and produce live young which disperse into the plankton. Seasons of copulation and larval release vary with species. Pacific Ocean perch grow slowly and may only be 30 cm in length by age 10. Thornyheads (*Sebastolobus*) release masses of gelatinous eggs that rise to surface waters. It is not known when fertilization occurs.

## MARINE INVERTEBRATES

Both the Gulf of Alaska and the Bering Sea support large numbers of marine benthic invertebrates, including commercially important shellfish species. Benthic, or bottom-living, species are generally categorized as *epifauna*, i.e. animals living on the sediments, or *infauna*, i.e. animals living in the sediments. Knowledge of benthic invertebrates in the Gulf of Alaska south of the Aleutians East CRSA is mainly limited to the larger, more conspicuous epifauna, particularly commercially important shellfish species. In the Bering Sea, more comprehensive information on both infauna and epifauna is available. Benthic invertebrates, in addition to supporting valuable commercial fisheries, are important food sources for many marine mammals, marine birds, and bottom-living fish species.

### Gulf of Alaska

Within the Gulf of Alaska there are approximately 14 species representing six families of commercially important invertebrates (Table 4-2). Of these species,

Dungeness crab, tanner crab, king crab, shrimp, and scallops are commercially harvested. Relatively little is known about the abundance or biology of Dungeness crab in this area although seasonal movements are known to occur. During summer Dungeness crab are found in soft sediments in shallow waters off river mouths; in the fall, they move offshore to deeper waters. Pandalid shrimp populations which used to be large in Aleutians East CRSA waters are currently depressed, although increased numbers of juveniles were reported in Pavlof Bay during a 1983 survey. Pink shrimp dominate the Aleutians East CRSA shrimp populations.

**Table 4-2: Commercially important invertebrate species in the Gulf of Alaska**

COMMON NAME	SCIENTIFIC NAME
Dungeness crab	<i>Cancer magister</i>
Tanner crab	<i>Chionoecetes bairdi</i>
Golden king crab	<i>Lithodes aequispina</i>
Red king crab	<i>Paralithodes camtschatica</i>
Pink shrimp	<i>Pandalus borealis</i>
Dock shrimp	<i>Pandalus danae</i>
Humpy shrimp	<i>Pandalus goniuris</i>
Coonstripe shrimp	<i>Pandalus hypsinotus</i>
Ocean pink shrimp	<i>Pandalus jordani</i>
Spot shrimp	<i>Pandalus playceros</i>
	<i>Pandalus montaquid tridens</i>
Sidestripe shrimp	<i>Pandalopsis dispar</i>
Weathervane scallop	<i>Pecten caurinus</i>
Razor clam	<i>Siliqua patula</i>

Source: Ronholt et al. 1978

### Bering Sea

The benthic infauna of the southeastern Bering Sea shelf may be divided into at least four distinct faunal domains which are correlated to the existing hydrographic domains of the area. An inshore community dominated by worms and clams is found shoreward of the 50-m isobath in sandy sediments. Productivity of this community is relatively high. The system is dependent on detritus; especially high biomasses are found off Izembek Lagoon, probably due to large eel grass inputs. A mid-shelf community is found in the silty sediments in 50 to 100 m of water. Standing stocks of invertebrates in this domain are relatively low. A less obvious faunal change occurs at 100 m depth, and another one at the shelf edge (Haflinger 1981). The epifauna of the southeastern Bering Sea off the Aleutians East CRSA is dominated by four species of commercially important crabs: red king crab, blue king crab, and two species of tanner crab (Jewett and Feder 1981).

## Life Histories

### KING CRAB

King crabs are not true crabs, but are more closely related to hermit crabs than to tanner crabs. They are characterized by the large size of the males at maturity, spiny bodies, and three pairs of walking legs (ADF&G 1977). There are three species of commercially important king crab in Alaska waters; red king crab (*Paralithodes camtschatica*), blue king crab (*Paralithodes platypus*), and brown or golden king crab (*Lithodes aequispina*). Of these species only red king crab are found in commercial quantities in the waters of the Aleutians East CRSA.

Red king crabs have the most widespread distribution of the king crabs and, until their recent precipitous population declines, were the most abundant species and accounted for the largest proportion of Alaska's king crab harvest. Red king crab inhabit the continental shelf out to the continental slope. They have been found at depths to 365 m, but the majority occur at depths less than 274 m with major concentrations usually found in waters less than 110 m deep on soft muddy or sandy bottoms (NPFMC 1982). Blue king crabs have a more discrete distribution pattern with major centers of abundance concentrated near islands in the Bering Sea (Pribilofs, St. Matthews, and St. Lawrence). The little-known brown king crab inhabits the deeper waters of the continental slope with major populations in the western Aleutians. Exploratory fishing for brown king crab off the South Peninsula is currently underway, but the presence of significant populations is not expected (Hilsinger, ADF&G, personal communication).

**Red King Crab:** Most research on red king crab has been carried out in either the Kodiak vicinity or the Southeastern Bering Sea/Bristol Bay area; relatively little specific information is available on South Peninsula populations. General life histories are probably quite similar for all areas but may vary in the timing of certain activities. The Bering Sea king crab stock appears to be one population in which individuals move and mix at random (BBCMP 1983). Gulf of Alaska stocks appear to be quite discrete, with little mixing among areas. Within the South Peninsula Fishing District, seven schools have been identified with the Pavlof school being the most productive in recent years.

The annual activity pattern of adult king crabs is dominated by two migrations. During the late winter and early spring (January through April), crabs move to inshore molting and spawning areas near Amak Island, Black Hills and Port Moller along the North Side of the Peninsula (Map D; BBCMP 1983) and into Pavlof, Ikatan, Morzhovoi, Beaver, and Belkofski Bays along the South Side of the Peninsula (Hilsinger, ADF&G, personal communication). The precise timing of the spawning migration varies from year to year and area to area. In the Kodiak area it occurs between January and April (Science Applications, Inc. 1980); in the Bering Sea it probably occurs somewhat later (BBCMP 1983). Males and females remain segregated during this migration, with females migrating first, followed by young adult males, and then older males.

Although female crabs must molt before mating, males need not. Males generally molt as they move to or occupy the breeding grounds. Older males (greater than 8 years of age) shed their exoskeleton only once every two or three years. Males generally molt before females of the same size. Peak molting of males in the Bering Sea occurs in April and May (BBCMP 1983) and from February through May in the Gulf of Alaska (Science Applications, Inc. 1980). The older skip-molt males may play a more important role in the reproductive success of the stocks than the younger or newly molted males (Curl and Manen 1982).

Upon arrival at the breeding grounds, females, who still have hard shells, form large concentrations and emit a chemical pheromone which attracts the males. Females then molt and must mate within five days for viable eggs to be produced. Eggs are extruded, fertilized, then attached to the pleopods (swimming legs) of the females, where they remain until hatching about 11 months later when females return to the breeding grounds. Males breed with an average of four females each season. Peak breeding in both the Bering Sea and the Gulf of Alaska occurs in April and May, coincident with peak molting (NPFMC 1982). Female king crab fecundity increases with size with the largest females producing up to 400,000 eggs. Egg-carrying females and adult males continue to feed in coastal waters before moving back to deeper waters in the summer and fall.

Although there are pronounced annual and inter-population variations, hatch of eggs and peak larval abundance occur from early April through mid-July, with a peak in early May. In the Bering Sea, larvae are concentrated in a narrow band in 40 to 70 m water along the North Aleutian Shelf from Unimak Island into Bristol Bay with larval concentration increasing dramatically between Unimak Island and Port Moller (Thorsteinson 1984). The distribution of larvae and young juveniles in South Peninsula waters is not known (Hilsinger ADF&G, personal communication). Upon hatching, the larvae are free-swimming and they may be moved significant distances from their hatching area by currents; consequently, significant stock mixing may occur during this period. There is thought to be some transport of larvae hatched in South Peninsula waters into the Bering Sea. Currents eventually concentrate the metamorphosed larvae in shallow nursery areas (less than 130 meters in depth). The precise locations of these nursery areas are not known, but survival from predation is thought to be greatest on gravelly and rocky substrates littered with clam shells where juveniles can hide. King crab population cycles suggest that year class success is primarily determined by the survival of larval and metamorphosing juveniles (Thorsteinson 1984).

First year juveniles lead solitary, secretive lives. They are often found in shallow, sometimes intertidal waters associated with algae and other invertebrates. During this first year they may undergo as many as 11 molts and reach about 11 mm in carapace length. During the next two years they undergo eight more molts and grow to about 60 mm. During their second and third years, young king crabs form tightly packed schools called pods, a behavior that is believed to protect them from predators. Pods are found year-round in shallow waters (usually less than 30 m) and are comprised of males and females of similar sizes. Podding behavior continues until at least the fourth year when the crabs again disperse, segregate by age and sex, and begin their annual migrations (BBCMP 1983).

Red king crabs mature at four to six years of age (95 to 100 mm carapace length) in both the Bering Sea and the Gulf of Alaska (BBCMP 1983, Science Applications, Inc. 1980, 1981). Red king crabs are thought to attain great age for crustaceans. The largest king crab caught in the Bering Sea was 197 mm in carapace length and was estimated to be over 20 years old.

The food and feeding habits of king crab vary with age, geographical location, and food availability. Larval king crab consume phytoplankton and some smaller zooplankton. Juvenile and adult king crab are bottom-feeding omnivores, with diatoms an important diet item for juveniles. Adults are able to take larger food items and molluscs, echinoderms, and other crustaceans become increasingly important prey items. Little information is available on predation on king crab by other species. Larvae are undoubtedly consumed by plankton-eating animals. Juveniles, because of their small size, are susceptible to predation by fish and large invertebrates. Adults are probably most susceptible to predation just after molting. Bearded seals, sea otters, cod, and halibut are known to prey on larger king crab (NPFMC 1982).

Population abundance estimates for king crab are made annually by NMFS for the southeastern Bering Sea and by ADF&G for South Peninsula waters. Populations in both areas have suffered precipitous declines during the last several years. In 1983 commercial fishing seasons in both areas were canceled due to severely depressed stocks.

The South Peninsula king crab population peaked in 1978 and has been declining ever since. ADF&G has encountered very few small crabs during its recent surveys, indicating several very weak year classes. In addition, the 1983 ADF&G survey found 28 percent of the mature females in Belkofski Bay to be barren. While this phenomenon has been widely seen in the Bristol Bay and Kodiak areas, it is the first time it has been observed in South Peninsula waters, indicating an insufficient number of mature males to service all females (Hilsinger, ADF&G, personal communication).

There are no simple explanations for the precipitous king crab population declines in both Bristol Bay and the Gulf of Alaska. Increased predation on larvae and pre-recruits by abundant codfish stocks, overfishing of certain schools, and unfavorable environmental conditions resulting in poor survival of larval crabs have all undoubtedly contributed to the population declines. As no strong age class of pre-recruits has been identified, it is difficult to predict when the area's king crab populations will recover.

#### TANNER CRAB

Tanner crabs are brachyurans or true crabs. Two species are commonly found in the waters adjacent to the Aleutians East CRSA: *Chionoecetes bairdi* and *C. opilio*. *C. bairdi* is present in South Peninsula waters, and *C. bairdi*, *C. opilio* and a hybrid of the two are present in the Bering Sea.

*C. bairdi* is found on the continental shelf to depths of 473 m throughout the Gulf of Alaska with greatest concentrations in waters between 50 and 100 m. In the eastern Bering Sea, *C. bairdi* and *C. opilio* overlap over much of their ranges but the respective centers of abundance are segregated according to water temperature (Otto 1981). *C. bairdi* is concentrated in the warmer (4.5° C) slope and outer continental shelf waters of the southern Bering Sea and *C. opilio* in the more northern colder waters north of 58° N latitude where bottom temperatures average 2.3° C (BBCMP 1983). The distribution of hybrid crabs coincides with the overlap areas.

*C. bairdi* is considerably larger than *C. opilio*. In both species, males and females have similar growth rates prior to maturity; males then continue to grow and females do not. *C. bairdi* females mature at about 82 mm carapace width, and males mature at 140 mm carapace width. The minimum legal harvest size for *C. bairdi* males is 140mm (5.5 in), and for *C. opilio* is 78mm (3.1 in).

Less is known about tanner crab biology than king crab biology. Maturing tanner crabs segregate into male and female schools and remain fairly sedentary throughout their adult lives. The mating season for tanner crabs varies with species and location. Mating occurs from February to early June in the Bering Sea (BBCMP 1983), and from January through May in the Gulf of Alaska (Science Applications, Inc. 1980).

In the Bering Sea, male *C. bairdi* undertake only limited migrations which are neither clearly directional nor seasonal. Rather, they appear to be part of a random search for females guided by the release of chemical attractants (pheromones) by the females. In the Gulf of Alaska, tanner crabs move inshore to shallower depths to breed, moving back to deeper waters in the fall. Except for these spawning movements, tanner crabs do not migrate over long distances (Science Applications, Inc. 1980).

Females mate while their shells are still soft after undergoing a terminal molt to maturity. Males breed in the hard shell condition and begin molting in late April in South Peninsula waters (Hilsinger, ADF&G, personal communication). In some cases the copulation that occurs at the terminal molt will be the only one in the female's life. Future ovulations are fertilized by spermatozoa stored during the original mating. In addition, some hard shell female matings are thought to occur (BBCMP 1983). Males are capable of mating with a large numbers of females.

After egg extrusion and fertilization, females carry their egg masses for about eleven months. Females of both tanner crab species are very fecund with *C. bairdi* females producing up to 318,000 eggs (169,000 average) and *C. opilio* females producing up to 150,000 eggs (36,273 average) (Thorsteinson and Thorsteinson 1984). About 20 percent of *C. bairdi* eggs are lost from the pleopods prior to hatching (BBCMP 1983). It appears that female tanner crabs control the time of hatching to coincide with phytoplankton blooms. In the Gulf of Alaska this means hatching usually occurs in late April to early May (Hilsinger, ADF&G, personal communication). In the Bering Sea there are two phytoplankton blooms; an early bloom in the wake of the receding ice edge and a later one in ice free locations. It is hypothesized the *C. opilio* may release larvae during the early bloom and *C. bairdi* during the later bloom (BBCMP 1983).

Neither precise spawning locations nor larval concentration locations are known for tanner crab, although larval occurrence is highest in the upper 60 m of the water column. Tanner crab larvae are free-swimming and take 12 to 90 days to develop with the duration of the larval period dependent primarily on water temperature (NPFMC 1981). Environmental factors such as ocean currents determine the depth and location at which juvenile tanner crabs settle, but they probably remain on the continental shelf. Preliminary data show that juvenile *C. bairdi* abundance increases dramatically between 50 and 70 meters of depth, especially between Amak Island and the Black Hills area (Thorsteinson 1984 et al. 1983). Juvenile tanner crabs form patch-like aggregations of similarly-sized individuals. Upon reaching sexual maturity at approximately five years for females and six years for males, the sexes segregate. At this life history stage, the relative abundance of adults and juveniles is quite different for the two species. *C. bairdi* juveniles and adults occur together throughout most of their range. However for *C. opilio*, some areas are occupied by juveniles and other areas are dominated by adults (BBCMP 1983).

The food and feeding habits of tanner crabs vary with age and food availability; larvae consume plankton, juveniles utilize a variety of benthic organisms and detritus, and adults are benthic omnivores. The predators of juvenile tanner crab are not well known, although individuals have been found in tomcod, Pacific cod and halibut stomachs. Predators of adults include snail fish, giant sculpins, and octopi (BBCMP 1983, Hilsinger, ADF&G, personal communication).

Populations of the larger sized males of both *C. bairdi* and *C. opilio* have declined over the last several years in the eastern Bering Sea. In 1983, the abundance of both legal-sized and pre-recruit *C. bairdi* decreased by 30 percent from the previous year. The distribution of *C. bairdi* crabs has remained the same in recent years with relatively high concentrations of legal-sized crabs located north of the Alaska Peninsula. There are no signs of rapid recovery for the *C. bairdi* population during the next several years. *C. opilio* populations are stable, however, they are at a lower level and individuals are smaller than during the late 1970's. More *C. opilio* was found immediately north of the Alaska Peninsula in 1983 than in previous years. Populations are expected to show small increases over the next several years (Otto et al. 1983).

In South Peninsula waters, sub-legal sized crabs declined precipitously during 1976-77 with populations being only about 10 percent of their previous abundance. In 1980, the occurrence of sub-legal crabs started increasing again and the population appears to have stabilized (Hilsinger, ADF&G, personal communications).

---

## **CHAPTER 5**

### **Anadromous and Freshwater Fish**

---

#### **SALMON**

All five species of Pacific salmon are found in the waters of the Aleutians East CRSA, with pink, chum, and sockeye salmon being most abundant. Coho and king salmon are found in relatively small numbers mainly in North Peninsula streams. In addition to the significant local salmon runs, adult salmon migrating to and juvenile salmon migrating from spawning streams throughout western Alaska, including the enormous Bristol Bay sockeye run, pass through the coastal waters of the Aleutians East CRSA.

All Pacific salmon species have similar life histories but differ in fecundity, food habits, growth rate, migration pattern, time spent in fresh and oceanic waters, age and size at maturity, and time and location of spawning (Straty 1981). All species are anadromous, ascending freshwater streams to spawn. Upon entering fresh water, adults cease feeding and die after spawning. Eggs are deposited in gravel redds that are excavated by the females. Both males and females may breed with several individuals. After hatching, the young, known as alevins, remain in the gravel and absorb their yolk sac until emerging sometime in the spring as fry. Greatest natural mortality occurs during the early freshwater stages. Life history summaries for the five salmon species found in Aleutians East CRSA waters are presented in Table 5-1.

**Table 5-1: Life history summary of the five species of Pacific salmon in Aleutians East CRSA waters**

Species	Freshwater Habitat	Time Spent in Freshwater after Emergence From Gravel	Time Spent at Sea (Yrs)	Typical Age at Spawning (Yrs)	Avg. Adult Weight (lbs.) <sup>1</sup>
Sockeye	Streams with Lakes	12-60 Months	1-4	3-7	5.8
Chum	Streams & Rivers	Up to 1 Month	1-6	3-5	7.2
Pink	Streams & Rivers	1 day, usually	1	2	3.6
King	Large Creeks & Rivers	3-12+ Months	1-6	3-7	17.9
Coho	Streams & Lakes	12-60 Months	1	3-5	7.5

<sup>1</sup>1981 averages from the commercial catch. Average weight of all species, especially sockeyes, can vary considerably from year to year.

**Sources:** Adapted from Straty 1981, Bristol Bay Cooperative Management Plan 1983, Shaul, ADF&G, personal communication

Differences between North and South Peninsula stocks include species composition and the timing of life history events. North Peninsula rivers and streams support large runs of sockeyes and chums along with a few locally important king and coho runs. Pink salmon streams are few. Along the South Peninsula, pink salmon predominate with sockeye and chum salmon also being important. Salmon enter South Peninsula waters before reaching North Peninsula waters and, with the exception of sockeyes, spawning continues until later in the season. These differences relate to differences between environmental conditions in the Gulf of Alaska and Bering Sea, and their associated streams. The approximate dates when local salmon populations enter coastal waters are shown in Table 5-2. In general, king salmon are first to enter coastal waters, followed by sockeyes, chums, pinks, and cohos.

**Table 5-2: Approximate timing of major life history events for salmon in the Aleutians East CRSA**

Species	ADULTS		JUVENILES	
	Enter Freshwater	Spawn	Emerge	Outmigrate
South Peninsula				
Pink	Jul 10-Aug 30	Jul 25-Sep 15	Mar 15-May 15	Mar 20-May 15
Sockeye	Jun 15-Aug 31	Jul 15-Sep 20	Apr 1-Jun 1	May 1-Aug 1
Chum	Jul 10-Sep 10	Jul 25-Sep 30	Feb 15-May 1	Unknown
Coho	Aug 20-Sep 30	Oct 1-Dec 30	Unknown	Unknown
King	* * * Not present in significant numbers * * *			
North Peninsula				
Pink	* * * Not present in significant numbers * * *			
Sockeye	Jun 15-Sep 20	Jul 20-Jan 15	mid Mar-mid May <sup>1</sup>	late May-mid Jul <sup>1</sup>
Chum	Jul 10-Aug 15	Jul 25-Aug 31	Unknown	early Jun <sup>1</sup>
Coho	Aug 15-Oct 30	Oct 1-Nov 30	Unknown	Unknown
King	Jul 1-Aug 1	Jul 20-Aug 20	Apr-Jun <sup>1</sup>	Jun <sup>1</sup>

<sup>1</sup>Quantitative data not available, general observations by ADF&G biologists.

**Source:** ADF&G 1977; Shaul, ADF&G, personal communication

Salmon spawning streams in the Aleutians East CRSA are shown on Map E. More detailed maps showing salmon spawning stream locations are available from the Alaska Department of Fish and Game Habitat Division. The movements of adult salmon through the offshore waters of the Aleutians East CRSA to local streams and streams outside the area are fairly well documented for the Bering Sea (Straty 1981) but less well defined for the Gulf of Alaska. The composition of the stocks passing through these waters at different times of the summer varies, but precise stock identification work is not available (Brannian 1983). It is believed that much of the Bristol Bay sockeye run travels through passes in the Aleutians East CRSA. Adults stay well out in the Bering Sea, although they occasionally come inshore between the Seal Islands and Cape Menshikof (Shaul, ADF&G, personal communication) before entering inner Bristol Bay in late June through mid-July. Juvenile salmon from both North Alaska Peninsula streams and Bristol Bay have been documented to move along the North Peninsula during their seaward migration. This migration lasts from late May to late September, depending on species. Juvenile sockeyes remain within 50 km of land until reaching Port Moller, then disperse in small, scattered schools but remain primarily in the top 2 to 5 meters of water. By early August, most sockeye juveniles are west of 159° W. latitude (including almost all Bristol Bay sockeyes); they reach Unimak Pass by early October (Straty 1981). The seaward migration routes of juveniles of the other salmon species are not as well known but are probably similar. Straty (1981) suggests that juvenile chum salmon movements are very close to the coast and are concentrated landward of most sampling efforts that have been conducted in the past along the North Peninsula.

There are no maximum sustainable yield (MSY) estimates for Alaska Peninsula salmon populations, nor are carrying capacity studies available for the region's streams. Escapement goals for major spawning streams are largely based on the professional judgement of the ADF&G area biologists. In general, all populations are healthy and have been at historical highs during the last several years (Shaul, ADF&G, personal communication).

## Life Histories

### PINK SALMON

Pink or humpy salmon (*Oncorhynchus gorbuscha*), is the smallest species of Pacific salmon. They are usually less than 55 cm (21.6 inches) in length and range in weight from 1.2 to 2.0 kg (2.6 to 4.4 lbs.). Pink salmon are not abundant in North Peninsula streams, but are the most abundant species in South Peninsula streams. Creeks entering Bechevin Bay support the only major run along the North Peninsula. Along the South Peninsula pink salmon are widely distributed but Mino Creek, Settlement Point, and Southern Creek on Deer Island occasionally produce nearly half the area's pink run. Apollo Creek and Middle Creek are also important streams which have a combined potential of producing 800,000 pinks (ADF&G 1977).

Pink salmon reach sexual maturity at age two, after one winter in freshwater as alevins and a second winter in the ocean. This results in distinct "odd" and "even" year stocks. In Alaska Peninsula waters, large runs can occur in both "odd" and "even" years, except for a few specific locations which are known to produce larger runs in "even" years (Shaul, ADF&G, personal communication).

Pink salmon spawning habitat is found at water depths of at least 0.15 m, over a wide range of current velocities (0.21-1.10m/s). Pink salmon are highly adaptable to a variety of spawning substrate types, including fractured bedrock with

pinks utilize marginal habitats, and often disturb previously deposited eggs. Spawning usually takes place when water temperatures are declining after reaching their summer maximum.

Temperatures greater than 4.5° C are required for initial egg development. Eggs develop in 8 to 10 weeks and hatch from December through February. The alevins remain in the gravel until spring. During this period mortality is very high, commonly over 90 percent. Major contributors to mortality include low dissolved oxygen concentrations, high or low stream discharges, low temperatures, mechanical disturbance, and predation. Pre-emergent fry densities are monitored in selected South Peninsula streams by ADF&G as part of their salmon forecasting program.

Following emergence from the gravel, pink salmon fry immediately migrate to the sea. During this migration, they do not feed but may be preyed upon by coho salmon, Dolly Varden, steelhead trout, and sculpins. Pink salmon fry school and feed in estuaries mostly on copepods and tunicate larvae for approximately a month prior to migrating to offshore waters.

Immature pink salmon range throughout the North Pacific for 12 to 18 months before beginning their homeward migration to natal spawning streams in the spring of their second year (BBCMP 1983).

Based on empirical data, ADF&G estimates an average return per pink salmon spawner of 2.5 to 3.4 individuals (ADF&G 1982).

### SOCKEYE SALMON

Sockeye or red salmon (*Oncorhynchus nerka*) are found in streams throughout the Aleutians East CRSA. However, the runs in this area are much smaller than the Bristol Bay sockeye runs to the east. Sockeye is the most important salmon species on the north side of the Peninsula with Bear River supporting the largest run. Other important runs are found in the Sandy River, the Nelson River, and in Ilnik and Uria Bays (ADF&G 1977, 1982). South Peninsula sockeye runs are numerous but generally small in numbers.

Adult sockeye salmon are typically 50 to 57 cm (20 to 22 inches) long and weigh between 2.4 and 3.6 kg (5.3 to 7.9 lbs.) when they return to spawning streams. The age of returning fish varies from year to year and location to location; sockeye salmon spend from 1 to 3 years in freshwater and 1 to 4 years in the ocean before returning to freshwater to spawn.

Most sockeye spawning takes place in gravel-bottomed inlet and outlet streams of lakes and along lake shores in shallow waters. Successful sockeye spawning has been documented in gravel and rock substrates 1.3 to 10.2 cm in diameter, in water velocities between 21 and 101 cm/s, and in water temperatures between 4.4° and 10° C. Intergravel water flow is especially important to egg survival (Morrow 1980).

Sockeye salmon spawning behavior is similar to other species of salmonids. Female sockeye normally produce 2,500 to 4,300 eggs which are deposited in three to five redds. Eggs usually develop in 6 to 9 weeks. Alevins hatch from mid-winter to early spring, but remain in the redd until emerging from the gravel as fry from April through June. Upon emergence, young fry concentrate near the shore of their freshwater habitats, moving into deeper waters as they grow. While in freshwater, young sockeye grow slowly and eat a variety of ostracods,

cladocerans and insect larvae. They compete with other freshwater fish for food and in turn are preyed upon by other species of fish including Dolly Varden, Arctic char, rainbow trout, and coho salmon (BBCMP 1983).

Young sockeye rear in lakes for one to three years, then migrate to the ocean in spring and summer. The year in which red salmon migrate primarily depends on size (7 to 13 cm) rather than age.

Smolts feed in the productive coastal waters and estuaries of the lower Alaska Peninsula. Immature sockeye salmon range throughout the North Pacific Ocean and central and western Bering Sea, migrating seasonally between these areas. The growth rate of sockeye in the ocean is related to food availability, competition, water temperature, and weather conditions. They grow rapidly during their first summer at sea, then more slowly thereafter (BBCMP 1983).

### CHUM SALMON

Chum or dog salmon (*Oncorhynchus keta*), are common in many of the river systems of the Aleutians East CRSA. The drainages of Izembek and Moffet Lagoons, Herendeen Bay, and the Sapsuk River which enters Nelson Lagoon are the major chum producers on the north side of the Peninsula. Along the South Peninsula, Canoe Bay is the major producer, but smaller runs enter tributaries of every major bay east of False Pass.

Chum salmon typically weigh 2.6 to 3.7 kg (5.7 to 8.1 lbs.) when they return to Alaska Peninsula streams. The age of returning fish varies from year to year but most chums are between two and four years old when they spawn.

Most spawning activity occurs in gravel-bottomed riffle areas of freshwater streams, although water temperature, discharge, and depth of spawning locations may vary widely. The spawning substrate consists mainly of small stones with some sand and silt.

Chum salmon fecundity is about 3,000 eggs per female, but varies with fish size. Eggs hatch in 7 to 14 weeks at temperatures between 4.4° and 13.0° C. After hatching, alevins remain in the gravel until April when emergence occurs. Mortality is very high during this period. Among the factors that contribute to egg mortality are low dissolved oxygen concentrations, high or low stream discharge, and low temperatures. Salmon fry remain in freshwater only a short time, then migrate to the sea in early June. Chum fry are preyed upon by a variety of fish including coho salmon, Dolly Varden, steelhead trout, and sculpins. Schools of juvenile chum salmon feed in estuaries and nearshore waters during the summer, then move to offshore feeding grounds by mid-August (BBCMP 1983).

Immature chum salmon move throughout the North Pacific and central and western Bering Sea for 1 to 6 years. In the winter, most juveniles are found in the North Pacific, primarily between 45° and 50° N latitude. During spring their distribution expands both north and south. In early summer, northward migration continues with some juveniles moving into the Bering Sea while others remain in the central and western North Pacific. Chums grow rapidly at sea where they feed on a variety of zooplankton, squid, fish and other organisms.

Mature chums start moving north in the spring and early summer. They are common off the north shore of the lower Alaska Peninsula from July 4 to 24 (Straty 1981). Chums appear earlier along the South Peninsula shoreline.

## KING SALMON

King or chinook salmon (*Oncorhynchus tshawytscha*), are not as common in Alaska Peninsula streams as the other salmon species. Small runs are found in many North Peninsula streams with the major run (about half the total North Peninsula king salmon production) occurring in the Sapsuk River. Few king salmon are found in South Peninsula streams due to a lack of suitable habitat. The Chignik River, which is outside the Aleutians East CRSA, is the only substantial run on the South Peninsula. Occasionally one or two kings stray into other streams (Shaul, ADF&G, personal communication).

King salmon is the largest species of Pacific salmon, weighing up to 57.3 kg (126 lbs.) but averaging only about 20 pounds in the North Peninsula commercial catch. The age of returning kings varies from year to year, but most are 5 or 6 years old when they spawn.

Most king salmon spawning occurs in large rivers in water depths ranging from 25 cm to 2 m, stream velocities from 0.3 to 1.5 m/s, and temperatures from 4.4° to 18° C. Kings prefer spawning areas consisting of 55 to 95 percent medium to fine gravel with less than 8 percent silt and sand. Intergravel water flow is critical to egg and alevin survival.

Female kings build their redd in areas of alternating riffles and pools where the strongest currents pass through the gravel. Redds are large and excavation may take several days. Fecundity has been reported between 3,000 and 20,000 eggs; however many eggs are lost in the swift current where the eggs are released.

Eggs develop in 7 to 12 weeks and alevins begin emerging from the gravel as early as April. King salmon fry stay in freshwater for up to one or two years before migrating to the ocean in early June. While in freshwater, kings feed mostly on aquatic insect larvae and terrestrial organisms that fall into the streams or rivers. The greatest natural mortality to king salmon occurs during the early stages of their freshwater residency. Juvenile kings stay only briefly in estuarine and coastal waters, feeding mostly on herring, sand lance, terrestrial insects, crustaceans, and molluscs.

Most juvenile king salmon move to deeper waters off the North Peninsula by the end of June. King salmon range throughout the central and western Bering Sea and North Pacific for one to six years before reaching sexual maturity. First year fish are most abundant in near shore waters, while older fish are more widely distributed. During their ocean residency king salmon grow rapidly, often gaining 0.5 kg per month. Their diet consists of zooplankton and a variety of fish including herring, sand lance, pilchards, walleye pollock, Pacific cod, tomcod, and smelt.

## COHO SALMON

Coho salmon (*Oncorhynchus kisutch*) are also called silver salmon. Information on the the distribution of this species in the Aleutians East CRSA is sparse. While all potential coho streams have not been surveyed, it appears that cohos are not as abundant in the streams of the Aleutians East CRSA as are other salmon species (Shaul, ADF&G, personal communication). There is a major run of coho salmon in Nelson Lagoon and widely scattered, small runs in several North Peninsula streams and bays including Moffet Bay, Urillia Bay, Swanson

Lagoon and the Ilnik River. South Peninsula runs are small and scattered but include runs in Thinpoint Cove, Mortenson Lagoon, Long John Lagoon, Russell Creek, Grub Gulch, Lefthand Bay, Beaver River, and the Stepovak River (ADF&G 1977).

Coho salmon generally spawn at the head of riffle areas in narrow side channels and tributaries of mainstream rivers. Preferred spawning areas have a substrate diameter range from 0.75 to 10.0 cm, water temperatures from 4.4° to 9.0° C, and stream velocities that range from 0.1 to 1.0 m/s. Coho fecundity ranges from 2,400 to 5,000 eggs depending on female size, with a mean fecundity of 3,500.

Eggs develop in the redd for 6 to 8 weeks and alevins remain in the gravel absorbing their yolk sac for 2 to 3 more weeks. The timing of fry emergence in Alaska Peninsula streams is not known, but probably occurs in May or June. Coho fry establish feeding territories in slow-moving water where they feed mainly on insects. As they grow, coho juveniles become serious predators on young sockeye salmon. In the Bristol Bay area and probably in North Peninsula streams, juvenile cohos typically remain in freshwater for one to three years before migrating to the sea. Juvenile cohos are abundant off the northern Alaska Peninsula in July and August before moving offshore. Coho salmon grow slowly in freshwater, very rapidly during their first year in the ocean, and more slowly thereafter.

Immature coho salmon usually range through the North Pacific and central and western Bering Sea for one year. They move with the prevailing ocean currents, making one complete circuit annually.

## FRESHWATER and OTHER ANADROMOUS FISH

Table 5-3 lists species of non-salmon anadromous and freshwater fish found within the Aleutians East CRSA and types of habitat in which they live. Map E shows the distribution of rainbow trout/steelhead within the region.

Very little site-specific information exists regarding anadromous and freshwater species of fish other than salmon in the Aleutians East CRSA. The ranges of some species such as grayling and northern pike, which are commonly associated with freshwater communities in Alaska, do not extend into this region. The same is true for the ranges of lake trout and burbot. Most of the fish present in this area have some association with salt water. The Pacific staghorn sculpin lives primarily in saltwater but forages into the lower reaches of coastal streams. Sticklebacks live in both freshwater and brackish water. Other species, such as eulachon, steelhead, and Pacific lamprey, are anadromous. Only the rainbow trout, slimy sculpin, coastrange sculpin, longnose suckers, and round whitefish can be considered strictly freshwater.

**Table 5-3: Non-salmon anadromous and freshwater fish**

Common Name	Scientific Name	Habitat*			
		Ocean	Bays & Estuaries	Rivers and Streams	Lakes
Rainbow trout	<i>Salmo gairdneri</i>	-	-	P	P
Steelhead	<i>Salmo gairdneri</i>	P	O	P	O
Dolly Varden/ Arctic char	<i>Salvelinus malma/</i> <i>S. alpinus</i>	P	P	P	P

Willie-spine stickleback	<i>Pungitius pungitius</i>	O	O	P	P
Slimy sculpin	<i>Cottus cognatus</i>	-	-	P	P
Coastrange sculpin	<i>Cottus aleuticus</i>	-	O	P	P
Arctic staghorn sculpin	<i>Gymnacanthus tricuspis</i>	P	P	O	-
Pacific staghorn sculpin	<i>Leptocottus armatus</i>	O	P	P	-
Sharpnose sculpin	<i>Clinocottus acuticeps</i>	O	P	O	-
Rainbow smelt	<i>Osmerus mordax</i>	P	P	P	-
Eulachon	<i>Thaleichthys pacificus</i>	P	P	P	-
Longnose sucker	<i>Catostomus catostomus</i>	-	-	P	P
Pacific lamprey	<i>Lampetra tridentata</i>	P	P	P	-
Arctic lamprey	<i>Lampetra japonica</i>	P	P	P	-
Round whitefish	<i>Prosopium cylindraceum</i>	-	-	P	P

\*P = Primary habitat; O = Occasional presence.

Sources: Morrow 1980, Carl et. al 1967, and Hart 1973

## Selected Life Histories

Life histories have been prepared for rainbow/steelhead, Dolly Varden/char, three-spine stickleback, slimy sculpin, rainbow smelt, and Pacific lamprey. These species were chosen as representing a broad ecological spectrum in this region.

### RAINBOW TROUT and STEELHEAD

Rainbow trout are found in only two locations within the Aleutians East CRSA (Map E). In other parts of Alaska the rainbow trout is an extremely important sport fish but the limited distribution here suggests that it does not have the same importance. Trout inhabit predominately cold, clearwater streams and lakes. They feed on insect larvae, crustaceans, plankton, and other invertebrates such as snails, leeches, and insects. Small fishes of other species may be eaten by adult trout.

Rainbows have a characteristic red band along their sides. Although some rainbow trout reach sizes up to 18 or 19 kilograms (48-51 lbs.), most are 1 to 2 kilograms (2.7-5.4 lbs.). Stream-dwelling trout do not migrate but remain in their natal streams throughout their lives. Rainbow trout which live in lakes move into streams in the spring to spawn but move back to the lakes in 3-6 weeks. Spawning takes place only in streams.

Spawning occurs between mid-April and late June. Riffle areas, usually above pools, are preferred spawning habitat. The female digs a redd in the gravel substrate while the male courts her. When the redd is completed, the pair position themselves side by side in the pit. Eggs and milt are extruded at the same time. The eggs fall into the gravel and are fertilized. The female then moves upstream and digs another redd. The gravel from the second redd covers the eggs in the first redd. Spawning occurs again and the process continues until the female has exhausted her egg supply. Usually, a female lays around 3,200 eggs total.

The eggs hatch in 4-7 weeks depending on water temperature; colder water temperatures increase development time. The trout fry remain in the gravel and absorb their yolk sac. This usually is complete within two weeks. Stream dwelling fish remain in the general area in which they were hatched and begin feeding. Lake-dwelling rainbows spend the next several weeks returning to the lake. Rainbow trout mature at 3-5 years. Unlike salmon, rainbow trout do not die after spawning.

Steelhead are the anadromous form of rainbow trout. Spawning, egg development, and hatching are the same. The fry remain in their natal streams for 1-4 years although the average appears to be two years. They then migrate downstream to saltwater. Here they will remain for up to four years. While in the sea, steelhead feed on fish and squid. Some populations disperse throughout the North Pacific, especially in the Gulf of Alaska area. Steelhead begin returning to their spawning streams in the fall, some as early as August, but spawning does not occur until the spring. Some fish do not arrive until the spring. Steelhead can reach 50-60 pounds in size but normally are 8-10 pounds when they return to spawn. Like resident rainbows, they do not die after spawning.

#### **DOLLY VARDEN/ARCTIC CHAR**

Dolly Varden and Arctic char are two very closely related species and, as such, will be discussed together. Both anadromous and freshwater populations of Dolly Varden and Arctic char (DV/AC) exist, although some authors (i.e. Morrow 1980) consider Arctic char to be mostly associated with lakes and Dolly Varden to be more often anadromous. DV/AC are harvested by sport fishermen and for subsistence use. In some cases, they are taken incidental to the commercial salmon harvest.

In the Aleutians East CRSA, DV/AC are distributed widely and are mostly likely present in any stream which contains salmon. They occur in both clear and glacial lakes and streams and brackish waters as well as nearshore ocean waters. DV/AC prefer cold water systems and can withstand temperatures as low as 0.5° C. Preferred temperatures for spawning in Southeast Alaska appear to be 5.5° to 6.5°C. It is not known if they exhibit the same temperature preference in this region.

Spawning occurs from late July to early December with the peak of spawning occurring between September and November. DV/AC dig redds and spawn similarly to other salmonids. The female digs the redd; both male and female enter the redd and extrude sperm and eggs simultaneously. Redd-building and spawning are repeated until the females's egg supply is exhausted. The number of eggs carried by each female varies from 600-8,000 depending upon factors such as size of the female and the stock from which she came. Most DV/AC die after spawning but some survive and spawn again in future years. Females are more likely to survive than males.

Length of time needed for egg and fry development is temperature dependent. Eggs incubate in the gravel over the winter and hatch generally 4 to 5 months after being laid. Alevins remain in the gravel for up to 18 days and absorb their yolk sacs. Fry begin feeding immediately on insects and larvae. Adults and young also feed on small fish of other species, fish eggs, insects, fish carcasses, and various invertebrates. DV/AC in marine waters consume mainly fish including herring, smelt, greenling, sculpins, juvenile salmon, and cod. They also will eat marine invertebrates such as euphausiids, polychaetes, amphipods, mysids, and isopods. Juvenile anadromous char remain in their natal streams and lakes for 2-7 years. After out-migrating, DV/AC remain in brackish water or nearshore coastal areas and do not migrate for long distances as do salmon.

Of the three forms of DV/AC, i.e., resident lake char, resident stream char, and anadromous char, stream DV/AC are the smallest at maturity. Lake char are usually around one kilogram (2.7 pounds) and anadromous forms are usually less than three kilograms (8 pounds). Age at sexual maturity ranges from 7-10 years in northern Alaska to 4-5 years in Southeast Alaska.

### **RAINBOW SMELT**

The rainbow smelt is another anadromous species found within the Aleutians East CRSA, mainly on the north side of the Alaska Peninsula. Although the rainbow smelt is harvested commercially and for sport elsewhere in the U.S., it is not present in sufficient numbers in this area to support such fisheries. It may, however, be taken to some extent as a subsistence resource.

Not much is known about the life history of rainbow smelt in Alaskan waters; most information is derived from the Great Lakes where they are particularly abundant. Rainbow smelt spawn in the spring after moving into the mouths of coastal streams. Smelt generally do not go very far up streams and some may even spawn in brackish water. The fish move into their spawning areas at night and spawn as a group over gravelly or sandy substrates. Spawning occurs several times with the female depositing less than 50 eggs each time. A female may carry as few as 1,000 eggs or as many as 69,000. Most fish die after spawning but some survive and spawn again the next year.

The eggs are sticky and adhere to the substrate and to one another. They hatch in 10 to 29 days depending upon water temperature. The young are weak swimmers and are quickly carried downstream to saltwater upon hatching. Rainbow smelt remain in estuaries and in nearshore coastal waters during their lives and do not undertake extensive migrations.

Young-of-the-year eat algae, eggs, copepods, cladocerans, and rotifers. Sexual maturity is reached at age two or three. Maximum life span appears to be six years and maximum length is around 24 centimeters. Adults in salt water consume copepods, small fishes, crabs, worms, squid, and other invertebrates.

### **THREE-SPINE STICKLEBACK**

The three-spine stickleback is an adaptable species and is found in a variety of habitats. There are freshwater, anadromous, and saltwater populations in Alaska. In freshwater, the stickleback is found in lakes, ponds, and streams. They overwinter in deep water, moving to more shallow waters in the spring. Breeding occurs in June and July. The male selects a territory and builds a cylindrical nest from vegetation, sand, and other materials. He then lures a female to the nest with a courtship dance. She enters the nest, lays her eggs, and leaves and the male enters to fertilize the eggs. Females lay 50-200 eggs per female. Females spawn several times, usually three or four days apart, during the season.

The male stickleback guards the nest usually throughout egg incubation. The eggs hatch in 6 to 14 days depending upon water temperature. The young absorb their yolk sac in about a week and attempt to emerge from the nest. The male catches them and spits them back into the nest, not allowing them to leave until they are fully formed.

Sticklebacks generally do not reach lengths longer than 10 centimeters. Sexual maturity is reached at one plus years. Food consumed by freshwater populations include copepods, cladocera, small molluscs, insect larvae, leeches, and their own eggs and young. In turn, sticklebacks are an important food species for Dolly Varden and other salmonids and fish-eating birds.

Anadromous sticklebacks inhabit eelgrass beds of lagoons and estuaries but have also been found in deeper saltwater areas farther from shore. These fish may spawn in saltwater or freshwater although it is suspected that egg survival may not be as great in saltwater. Spawning behavior is similar to that exhibited by freshwater sticklebacks. After emerging from the nests, anadromous sticklebacks hatched in freshwater water will head downstream to saltwater. In saltwater, sticklebacks feed on small fishes of other species, larval crustaceans, and molluscs.

### **SLIMY SCULPIN**

The slimy sculpin is a freshwater species which inhabits lakes and swift-flowing streams. It lives on the bottom of waterbodies and is well camouflaged so that it is not easily seen unless it moves. Sculpins are not harvested by man except occasionally as bait.

Sculpins do not migrate and are rather sedentary fish. They may move into shallow water to spawn. Slimy sculpins spawn in the spring shortly after break-up. Males choose nest sites usually under logs or rocks. The nest is dug out by the male who may carry away rocks from the site leaving a depression with a sandy bottom. The male sculpin defends his nest vigorously, often killing other intruding males. Female sculpins are herded into the nest by the male who then induces her to spawn by biting her flanks. The female turns upside down and lays her eggs on the roof of the nest while the male presses against her and releases sperm. Females spawn once, depositing between 40 to 1,400 eggs. Males may mate with several females. They then remain with the eggs until they have hatched and the young fish are ready to leave the nest.

Eggs hatch in about 30 days. The young move to the bottom of the nest and stay there until their yolk sacs have been absorbed, about one week. Sexual maturity is usually reached at age two. Slimy sculpins consume insects and occasionally eggs and young fish of their own and other species.

### **PACIFIC LAMPREY**

The Pacific lamprey belongs to a primitive class of fish which have cartilaginous rather than bony skeletons and which are agnathus, i.e. lack jaws. Instead they have funnel-like mouths which are lined with horny "teeth". Lampreys are elongated and have no true fins; they have two dorsal "finfolds" and one ventral fold. They also have no scales, but instead have a smooth skin covered with a protective slime.

The Pacific lamprey is anadromous, moving upstream in the summer and fall. However, they are not sexually mature at this time and do not spawn until the following spring. Nests consist of a shallow pit dug in fine gravel near the head of a riffle. During spawning, the female attaches her mouth to a rock and the male attaches to her head, wrapping his body around hers. Eggs and sperm are released simultaneously and the adults die shortly after spawning. Females may produce up to 100,000 eggs.

Eggs hatch in two to four weeks and the larvae bury themselves in the sandy stream bottom. The larvae are blind and have no sucking discs. They live on the stream bottom for several years as filter feeders. After metamorphosing into the adult form, the lampreys go downstream to the sea. Here they are parasites on other fish, especially salmonids. They rasp through the scales of the host fish and feed on its blood and other body fluids. It is not known if this parasitism actually kills a large number of salmon or if most host fish adapt to it. The lamprey is not harvested by man but is consumed by other fish including salmon and trout.

---

## **CHAPTER 6**

### **Marine Mammals**

---

Twenty-four species of marine mammals are permanent residents or seasonal occupants of the northern Gulf of Alaska and southern Bering Sea waters adjacent to the Aleutians East CRSA (Table 6-1). The offshore, estuarine, and lagoon coastal habitats provide important habitat for marine mammal breeding, feeding, resting, pupping, and migration. Offshore waters north of the Peninsula provide critical habitat for several species of marine mammals in the form of relatively restricted migration pathways, important feeding locations in biologically productive areas of oceanic upwelling, and coastal and shoreline habitats for breeding, resting, molting, and protection from sea ice incursion. The ice-free waters south of the Alaska Peninsula and the numerous islands, shallow coastal waters, and remote, rocky shorelines provide important feeding, pupping, and haul-out areas for marine mammals of the northern Gulf of Alaska. Unimak Pass is an especially important migratory pathway for fur seals, gray whales, fin whales, and humpback whales. Gray whales, harbor seals, and sea otters are the most visible and numerous marine mammals of the nearshore area. With the exception of minke whales, all of the filter-feeding baleen whale species in Bristol Bay (humpback, fin, bowhead, gray, and sei) are considered endangered on the federal list of endangered species (Science Applications, Inc. 1981). Important use areas for marine mammals in the Aleutians East CRSA are shown on Map F and discussed in the following summaries of pertinent life history information.

#### **DISTRIBUTION AND LIFE HISTORY INFORMATION**

##### **Right Whale**

Whaling records indicate that approximately 40 percent of the right whales harvested during historic commercial whaling were taken in the Gulf of Alaska. This species is generally sighted in the western Gulf of Alaska from May to August, with an increase in number of sightings during June and July in coastal waters and near land masses. Right whales mate and calve during the winter months at lower latitudes, migrating to Gulf of Alaska waters in the spring.

##### **Fin Whale**

Fin whales were historically one of the species most sought by commercial whalers in the north Pacific. Traditional whaling grounds included the coastal waters of the Aleutians East CRSA. The combined population of fin whales in the Gulf of Alaska and Bering Sea probably does not exceed 10,000 animals

**Table 6-1: Marine mammals of the Aleutians East CRSA and their occurrence in the southern Bering Sea and northern Gulf of Alaska**

Common Name	Area of Occurrence	
	Bering Sea	Gulf of Alaska
Right whale*	3	3
Fin whale*	1	2
Sei whale*	3	1
Blue whale*	—	2
Bowhead whale*	2-3	—
Minke whale	1	1
Humpback whale*	2	2
Gray whale*	1	1
Sperm whale*	2	2
Killer whale	1	1
Short-finned pilot whale	2	3
North Pacific giant bottle nose whale	2	2
Goosebeak whale	3	3
Bering Sea beaked whale	2	3
Belukha whale	2	2
Dall's porpoise	1	1
Harbor porpoise	1	1
Pacific white-sided dolphin	1-2	1
Risso's dolphin	3	3
Northern right whale dolphin	3	2
Northern sea lion	1	1
Northern fur seal	1	1
Harbor seal	1	1
Bearded seal	2	—
Spotted seal	2	—
Ringed seal	3	—
Ribbon seal	3	—
Walrus	1	2
Sea Otter	1	1

\* Endangered Species

1 = Common inhabitant

2 = Casual inhabitant

3 = Rare

— Not known to occur

Sources: Morris et al. 1983, Schneider 1981, Science Applications, Inc. 1981, Gusey 1979, Consiglieri and Braham 1982

(Morris et al. 1983). After wintering in southern latitudes, fin whales begin arriving in the western Gulf of Alaska and eastern Aleutian Islands by April and May. During their spring and summer seasonal presence in Alaskan waters, they spend much of their time in coastal waters and should be considered a nearshore inhabitant.

In the Gulf of Alaska, most sightings of fin whales are shoreward of the 200 m contour where they inhabit areas of upwelling along the continental shelf of the Gulf, especially in the western area. The continental shelf margin and slope from Albatross Bank to the Shumagin Islands is an area of high occurrence for these whales. Fin whales depart the Bering Sea in September, and few fin whales have been observed in the Gulf of Alaska later in the fall.

## **Sei Whale**

In the spring, sei whales migrate northward from winter resting and reproduction grounds to summer feeding areas in the Gulf of Alaska. From May through August, the northwestern Gulf of Alaska supports a high density of sei whales prior to commencement of their southward migration in the fall. Sei whales feed near the surface with copepods, euphausiids (krill), and squid comprising much of their diet. An average-sized sei whale requires about 1,300 to 1,700 pounds of food each day.

## **Blue Whale**

Extensive commercial exploitation of the blue whale in the North Pacific between 1910 and 1965 reduced the population from an estimated 4,800 animals to the current level of approximately 1,500. Blue whales arrive in the Gulf of Alaska in late spring (April and May) to occupy two general areas of concentration. One area of abundance for blue whales occurs from 160 to 180 longitude, encompassing the South Peninsula offshore waters of the Aleutians East CRSA. Feeding activity occurs in this area from June through August, with southbound migration commencing in September. There is little geographic movement by blue whales while on their feeding grounds. In the North Pacific, blue whales feed almost exclusively on krill with an average adult whale consuming about four tons daily during the summer months.

## **Minke Whale**

Although population estimates are not available for this species, the minke whale is generally regarded as abundant in the Gulf of Alaska. They are only occasionally found in the southern Bering Sea. Following their arrival in the Gulf in the spring, minke whales are commonly found in both continental shelf and inland waters. More than 95 percent of all sightings are made within the 200-m contour, mostly in shallow coastal waters. Minke whales are most abundant in Gulf waters during the summer where historic whaling activity found them abundant in the eastern Aleutian Islands. Along the north coast of the Peninsula, minke whales have been observed during April and June (Frost et al. 1982).

By October, most minke whales have departed the Gulf of Alaska for southerly breeding and wintering areas. Locally abundant fish, euphausiids, and copepods are the principal prey of the minke whale with the most common fish species consumed being pollock, herring, sand lance, cod, and salmon.

## **Humpback Whale**

Humpback whales have been protected from commercial whaling since 1966. From a pre-exploitation population of approximately 15,000 animals, the current population in the North Pacific is estimated at 850-1200 whales. Humpback whales are considered an endangered species; their population depletion in the Pacific is exceeded only by that of the North Pacific right whale. No estimates of abundance are available for this species in the Gulf of Alaska.

Humpback whales arrive in Gulf waters in April to May; traditional sightings at this time generally occur east of the Aleutians East CRSA. Humpbacks display an affinity for nearshore waters. The majority of the sightings in the Gulf of Alaska occur in highly productive fjord-like bays and around islands. Humpback whales remain in the northwest Gulf through November. Some researchers believe that humpbacks wintering in Asiatic waters summer in the Bering Sea, Aleutian Islands, and perhaps east to Kodiak Island. The diet of the humpback whale varies with location; however, they generally feed on schooling fish (herring, pollock, capelin, mackerel, saury) and euphausiids.

### **Gray Whale**

The Pacific Ocean population of gray whales is comprised of two stocks, one of which occurs in the waters of the Aleutians East CRSA. This eastern stock is currently estimated at 15,000 to 17,000 animals of which 13,000 to 17,000 enter the coastal waters of the Gulf of Alaska twice annually. Gray whales have apparently recovered from the commercial exploitation which occurred from 1846 to 1946, and the population has probably returned to a pre-whaling level.

Gray whales migrate 9,000 to 14,000 km each spring from mating and calving areas off the coast of California through the Gulf of Alaska to feeding grounds in the Bering and Chukchi Seas. Most of the whales entering the Aleutians East CRSA migrate into the Bering Sea. The number of gray whales remaining in the Gulf of Alaska during the summer (June through September) is unknown but is probably no more than a few hundred animals (Morris et al. 1983). The gray whale migration route through the Gulf of Alaska is entirely coastal with most gray whales remaining within 2 km of the shore except for more offshore movement between Kodiak Island and the Alaska Peninsula. Spring migration in the Gulf of Alaska occurs from April through June. Single adults (including pregnant females) and subadults generally arrive first, followed by post-mating males and females with young calves. Feeding, mating, and resting activities occurred during migration.

During a spring census of migrating gray whales passing Cape Sarichef, animals were observed moving northward within 500 m of the coast and, on occasion, within 25 m of the shoreline. Through observations and aerial surveys, it was determined that gray whales stay in the eastern part of Unimak Pass during spring migration (Hessing 1981). Movement of gray whales into the Bering Sea via Unimak Pass is generally complete by the end of June or early July. Gray whales are regularly observed near shore as they move along the coast of the North Peninsula through Bristol Bay. They generally remain near shore until reaching Nunivak Island (Science Applications, Inc. 1981). Gray whales are present every year in small numbers in and near the Nelson Lagoon/Port Moller area between April 18 and November 23 (Frost et al. 1982). Whales have been observed feeding inside Nelson Lagoon between Cannery Island and the Village Peninsula, and between Gull Island and the Kudobin Islands. They have also been reported foraging in upper Nelson Lagoon (approximately 12 km southwest of Lagoon Point), Herendeen Bay, and upper Port Moller (Gill et al. 1977). Although small numbers of gray whales remain along the north shore of the Peninsula throughout the summer, the importance of apparently traditional feeding areas, particularly Nelson Lagoon, has not been investigated (Thorsteinson 1984).

Gray whales are predominantly a coastal species, seldom found in waters greater than 1,800 m in depth. They are more commonly found in coastal waters of less than 100 m. This affinity for proximity to the shoreline during

During the southward migration out of the Bering Sea in November and December, an estimated 90 percent or more of the gray whale population moves through the offshore waters of the North Peninsula adjacent to the Aleutians East CRSA. Daylight surveys of gray whales moving south through Unimak Pass near Cape Sarichef have estimated that 17,000 whales migrated through the area in 1979 (Science Applications, Inc. 1981).

In late October, gray whales begin their departure from the Bering Sea and enter the Gulf of Alaska. The peak of southward migration in the Gulf occurs during the last week in November, and all gray whales have left the area for southerly destinations by early January. The abundance of gray whales in the Gulf of Alaska is probably greatest during late November. Recent observations suggest that the southerly migration is as close to the coast as the northward spring migration. Calving and mating occur after gray whales have left Alaskan waters.

Gray whales feed heavily on benthic organisms including ampeliscid amphipods, euphausiids, tubeworms, crabs, and polychaetes. During spring migration gray whales have been observed to bring mud and sand to the surface and expel it in the same manner as when feeding in the northern Bering Sea. Schooling fish such as capelin and herring may also provide a limited food source during migration.

### **Sperm Whale**

The sperm whale is the largest of the toothed whales. Commercial harvests of sperm whales in the North Pacific have been continuous for more than three centuries. Since 1966, annual harvest levels for this species have been reduced from approximately 7,000 animals in the late 1970's to a 1980-81 harvest limit of 890 males, all to be taken from stocks west of Amchitka Pass. Whaling records show little harvesting of sperm whales in the Gulf of Alaska during the past several decades, suggesting that the species is not as abundant here as in waters to the south and west.

Sperm whale are characteristically found in deeper waters of the outer continental shelf and slope. In spring, they are widely distributed in the Gulf of Alaska. Most sperm whales found in the productive feeding grounds of the northern Gulf of Alaska and southern Bering Sea are generally adult males that are not participating in mating and immature males (bachelor schools). Adult female and juvenile sperm whales form "maternity schools" which show distinct preference for warm surface water temperatures. Since these conditions are not present in the northern Gulf, maternity schools are usually not found in that area. Summer sightings of sperm whales suggest that deeper water areas to the east and south of the Aleutians East CRSA are probably preferred habitat in the Gulf of Alaska. By early autumn, sperm whales present in the Gulf are migrating south.

Sperm whales generally feed from mid-water depths to the ocean floor with a preponderance of bottom-dwelling species found in sperm whale stomachs. Fish species eaten by sperm whales in the Bering Sea include the smooth lump sucker and rockfish; squid have been reported in the diet of sperm whales harvested in the Gulf of Alaska.

## **Killer Whale**

Although population estimates are not available, killer whales may be considered abundant and ubiquitous in the Gulf of Alaska and a regular inhabitant of the southern Bering Sea. Killer whales are seasonal residents of the Bering Sea, and probably year-round residents of the nearshore waters of the Gulf of Alaska. In the spring, killer whales are distributed throughout the Gulf in shelf waters less than 200 m in depth. During fall and winter months, killer whales are most numerous around Kodiak Island and adjacent shelf waters east of the Aleutians East CRSA.

The distribution and movements of killer whales are related to the availability of prey. Nearshore migrations of whales along the north side of the eastern Aleutian Islands and Alaska Peninsula are probably linked to inshore migrations of pelagic fish such as salmon and other schooling fishes. Killer whales are known to prey on marine mammals and may take gray whales and walrus in the Bering Sea. Northern sea lion, minke whale, Dall's porpoise, and harbor porpoise are commonly taken by killer whales near the Aleutian Islands and in the Gulf of Alaska. Killer whales are adept at group hunting, particularly when feeding on marine mammals.

## **Dall's Porpoise**

The Dall's porpoise is a common inhabitant of the Gulf of Alaska and the southern Bering Sea. The Gulf population is estimated at 136,000 to 253,000 animals with density estimates ranging from 0.3 to 0.5 animals per square nautical mile. The approximate northern limit of their range is Cape Navarin in the Bering Sea.

Dall's porpoise are present year-round in the Gulf of Alaska. Local migrations and seasonal onshore-offshore movements may occur along the coast. During fall and winter, distribution does not appear to be correlated to bathymetry, but sightings of larger groups of Dall's porpoises (20+ animals) during spring and summer are almost exclusively in outer shelf and slope waters.

Information concerning the feeding habits of Dall's porpoise is sparse; however, they have been reported to take capelin, hake, herring, lantern fish, and several species of squid.

## **Harbor Porpoise**

Harbor porpoises are a widely distributed but apparently low density marine mammal that generally occupies coastal waters such as harbors, bays and the mouths of rivers in both the Bering Sea and the Gulf of Alaska. They are usually sighted singly or in pairs (Morris et al. 1983). Harbor porpoises have been reported in the Port Moller-Cape Seniavin region between April and June (Frost et al 1982). Small fish such as cod, herring, and mackerel comprise the principal foods of harbor porpoises.

## **Pacific White-Sided Dolphin**

Population estimates for the Pacific white-sided dolphin are not available for the Gulf of Alaska or the southern Bering Sea, but this species is seasonally abundant in the Gulf during the spring. The largest groups of Pacific white-sided dolphins have been associated with the continental slope, and the majority of sightings occur between the 200- and 2000-m isobath. This

feeding level between the 200- and 2000-m isobath. This species is probably an opportunistic feeder, consuming fish and squid species similar to the diet of Dall's porpoises.

### **Belukha Whale**

Belukha whales, or white whales, are present in both the Gulf of Alaska and the southern Bering Sea. These whales generally frequent shallow waters, bays, and estuaries which are often turbid and warmer than offshore waters. Coastal waters in which belukhas congregate are also used by anadromous fish, a preferred prey of these whales. Along the north shore of the Alaska Peninsula, major concentrations of belukha whales are present throughout the year and seasonally abundant in inner Bristol Bay, east of the Aleutians East CRSA. Belukha whales are occasionally reported in the vicinity of Port Moller (group of 300 in April 1976) and in False Pass (Hessing 1981), but their occurrence in the area is sporadic. Local observers consider belukhas to be very uncommon along this portion of the Alaska Peninsula (Frost et al. 1982). In the Gulf of Alaska, principal use areas for this species are east of the Aleutians East CRSA near Kodiak Island.

### **Northern Sea Lion**

The northern sea lion, also known as Steller's sea lion, is a widely distributed marine mammal over the continental shelf of the southern Bering Sea and northern Gulf of Alaska. While at sea, this species frequents continental slope and shelf waters shallower than 2,000 meters; however, during much of the year the sea lion occurs in greatest numbers near the shelf break at the 200 m depth contour. This area of major abundance on the south side of the Peninsula is from the western Gulf of Alaska to the western Aleutian Islands (Morris et al. 1983). The population of the sea lions in the eastern Aleutians decreased from more than 50,000 in 1957 to less than 25,000 in 1977. Eighty percent of the sea lion population in the eastern Aleutians is found in the Fox Island group, adjacent to the west boundary of the Aleutians East CRSA (Science Applications, Inc. 1981).

A sea lion rookery is a terrestrial site where all adult males actively defend territories and where birth of pups and breeding takes place. Rookeries may be used as haul-outs during the remainder of the year. A haul-out is any area where sea lions come ashore on a regular, predictable basis but where few or no pups are born. Areas where sea lions are reported on land on an irregular basis are characterized as stopover areas (Calkins and Pitcher 1982). Sea lion rookeries, haul-out sites, and stopover areas within the Aleutians East CRSA are shown on Map F.

Adult sea lions begin to gather on breeding rookeries in late May and occupy these areas through October. Some areas are used as haul-outs only in the winter, while others are used by sea lions only during the breeding period. Within the Aleutians East CRSA, Gulf of Alaska locations used by sea lions as haul-out sites and rookeries are listed in Table 6-2. Identified stopover areas used by sea lions are listed in Table 6-3. Although all of the major pupping rookeries are used throughout the year, the numbers of sea lions present are likely to be reduced during the winter.

**Table 6-2: Haul-out sites and rookeries used by northern sea lions in the Aleutians East CRSA**

Location (Coordinates)	Number of Sea Lions Observed <sup>1</sup>
Spitz Island Haul-Out (55 47' 20" N, 158 53' 40" W)	25-700
Lighthouse Rocks Haul-Out (55 47' 00" N, 157 25' 00" W)	1078-1315
Castle Rock Haul-Out (55 15' 45" N, 159 29' 45" W)	189-541
Atkins Island Rookery (55 03' 05" N, 159 17' 50" W)	1211-9500 +
Chernabura Island Rookery (54 45' 15" N, 159 33' 00" W)	1437-3303
Nagai Island Haul-Out (54 56' 00" N, 160 15' 10" W)	15-405
Sea Lion Rocks Haul-Out (Shumagin) (55 04' 50" N, 160 30' 45" W)	187-400
Jude Island Haul-Out (55 15' 50" N, 161 06' 20" W)	0-3000
Pinnacle Rock Rookery (54 46' 15" N, 161 45' 45" W)	141-5479
Clubbing Rocks Rookery (54 42' 50" N, 162 26' 45" W)	0-5600
South Rock Haul-Out (54 17' 43" N, 162 42' 20" W)	972-3200
Bird Island Haul-Out (54 40' 10" N, 163 17' 20" W)	0-260
Rock Island Haul-Out (54 36' 30" N, 163 36' 30" W)	25-54
Cape Lutke Haul-Out	22

<sup>1</sup>Includes high and low numbers reported during all seasons of observation.

Source: Calkins and Pitcher 1982

**Table 6-3: Sites within the Aleutians East CRSA used as stopover locations by northern sea lions**

Location	Latitude	Longitude
Kupreanof Point	55 33' 55" N	159 35' 45" W
Whaleback Island	55 16' 50" N	160 05' 05" W
Haystacks	55 16' 30" N	160 30' 10" W
Unga Cape	55 07' 55" N	160 31' 25" W
Simeonof Island	54 51' 50" N	159 18' 00" W
The Twins	54 57' 35" N	159 52' 00" W
Wosnesenski Island	55 09' 40" N	161 20' 20" W
Cherni Island	54 37' 20" N	162 22' 30" W

Source: Calkins and Pitcher 1982

Sea lions begin concentrating at pupping rookeries by mid-May, building to peak numbers from mid- to late June. Atkins Island, Chernabura Island, Clubbing Rocks, and Pinnacle Rocks in the Aleutians East CRSA are the sites of four of the ten most important pupping rookeries in the Gulf of Alaska (Calkins and Pitcher 1982).

North of the Alaska Peninsula in Bristol Bay, sea lions utilize haul-out areas on Unimak Island, Amak Island (including Sea Lion Rocks and nearby unnamed rocks), and Cape Seniavin. The three principal haul-outs on Unimak Island are Sea Lion Point/Cape Sarichef, Okseanof Point, and Cape Mordvinof. Sightings in these locations have occurred from March through August with more than 4,000 sea lions observed hauled-out onshore in 1960 and less than 100 animals noted in 1975-77 (Frost et al. 1982). Sea Lion Rocks adjacent to Amak Island is currently the largest haul-out and the only large rookery for sea lions in Bristol Bay (Map F). Animals are present along the rocky shorelines from early March until mid-October, with greatest numbers of sea lions utilizing the area from April to August. Between 1960 and 1981, the number of sea lions observed declined from approximately 3,500 to 2,000 animals. Amak Island is used as a haul-out by more than 1,000 sea lions each year, but does not serve as a rookery (Frost et al. 1982). Cape Seniavin is the farthest east haul-out recorded for sea lions along the north shore of the Peninsula. Sea lion haul-out sites are considered critical habitat because of their limited numbers and high density use. Alteration of these areas through disturbance or habitat destruction could have a significant impact on use of the Aleutians East CRSA by sea lions.

Late in the summer and fall, sea lions are likely to appear farther offshore than in the spring with most sightings shoreward of the 200 m contour from the northern Gulf to Unimak Pass (Morris et al. 1983). Large groups commonly make feeding forays ranging from 5 to 15 miles from shore. Single animals and smaller groups of 2 to 12 sea lions are more likely to venture further from shore. During fall, sea lions are common along the continental shelf break from the Shumagin Islands to Unimak Pass. During September and October, significant numbers of animals haul-out on land to molt.

Seasonal shifts in distribution and gradual, directed movements of sea lions during each annual cycle have been reported. These migratory movements may be correlated with age classes and sex of sea lions. Documentation of seasonal movements are difficult to verify since an estimated 40 percent of the sea lion population is at sea at any one time during the summer (BBCMP 1983). Specific movement patterns between the Shumagin Islands and the south side of the Peninsula, and other areas within the Gulf of Alaska cannot presently be determined with the data and observations currently available (Calkins and Pitcher 1982).

The northern sea lion is the largest of the eared seals. Males often exceed 3 m in length and weigh over 2,200 pounds. Female sea lions are noticeably smaller averaging 2.1 m in length and weighing 600 pounds. The age of sexual maturity is 4 to 5 years for females and 5 to 7 years for males. On large rookeries, male sea lions generally collect 14 to 17 females within their defended territories. There appears to be a directed effort by female sea lions to return to the rookeries of their birth for pupping (Calkins and Pitcher 1982).

Sea lion pups are born between mid-May and mid-July, peaking during mid-June. Most females breed within a week or ten days after giving birth (Gusey 1979). There are indications that weather and sea conditions can occasionally prevent access to the rookeries by sea lions; these circumstances have been noted at Chowiet Island in the Semidi Islands and at Clubbing Rocks and Pinnacle Rock in the Sandman Reefs.

Sea lions are opportunistic feeders, consuming flatfish, rockfish, or invertebrates that may be abundant. Their principal period of feeding activity appears to be at night, and the more common food items include walleye pollock, herring, squid, capelin, salmon, Pacific cod, and sculpins.

Mortality of sea lion pups is highly variable since it is due principally to weather conditions and crowding effects on the birthing grounds. The principal natural predators of sea lions include sharks and killer whales.

### **Northern Fur Seal**

The fur seal is a wide-ranging species in the north Pacific and southern Bering Sea with the greatest concentration of animals found in the summer and early fall near their breeding islands. It is estimated that 1.0 to 1.3 million fur seals return annually to the Pribilof Islands in the Bering Sea northwest of the Aleutians East CRSA. Unimak Pass is a major spring and fall passageway for the highly migratory fur seals as they move from wintering grounds in the Pacific to breeding grounds on the Pribilof Islands (BBCMP 1983). Some immature fur seals of 1 to 2 years of age may remain at sea year-round.

During the fall migration from breeding areas in the Pribilof Islands to wintering areas as far south as Mexico, females and juvenile male fur seals travel through Unimak Pass from mid-November to early December. During this period, fur seals are distributed from south of Unimak Pass to the Pribilof Islands in a broad strip approximately 200 miles wide and 250 miles long. Adult males appear to remain in the northern waters of the Gulf of Alaska and possibly the southern Bering Sea during the winter, but their precise distribution is unknown.

Fur seals wintering south of the Gulf of Alaska migrate north through the Aleutians East CRSA from late April to June. This population is presumed to include animals that have left the Bering Sea to overwinter in the warmer waters of the Gulf. During summer, concentrations of fur seals occur near the shelf break from Kodiak Island to Unimak Pass.

Male and female fur seals differ greatly in size with females weighing from 66 to 110 pounds and bull males between 300 to 460 pounds. Females are sexually mature at 4 or 5 years of age and usually bear a single pup each year. The maximum life span of fur seals probably does not exceed 30 years.

Fur seals feed primarily at night when prey may be more abundant near the surface. Their principal foods include pollock, capelin, sand lance, herring, Atka mackerel, Bathylagid smelt, and several species of squid. Although sea lions are known to dive as deep as 200 m, most feeding dives are at depths of 20 to 100 m lasting 1 to 5 minutes.

Mortality factors for this species include predation by killer whales, diseases, and entanglement with fishing gear. They are exceptionally vulnerable to oil spills as recent studies have shown that small amounts of crude oil in the fur cause increased loss of heat, rendering their fur ineffective as an insulator.

## Harbor Seal

The harbor seal, also known as the hair seal, is distributed along the entire coastline of the Aleutians East CRSA and is generally found nearshore in relatively sheltered waters. Although harbor seals are primarily a coastal inhabitant, they have been observed up to 100 km offshore and in coastal rivers and lakes (BBCMP 1983). The world's largest breeding colony of harbor seals (minimum population 13,000 animals) is located east of the Aleutians East CRSA on Tugidak Island, southwest of Kodiak Island.

In the Aleutians East CRSA area, the principal haul-out area for harbor seals on Unimak Island is Cape Lapin. To the east, False Pass (Cape Krenitzin and Isanotski Islands), Izembek/Moffet Lagoons, and Nelson Lagoon/Port Moller provide major haul-out areas for harbor seals with maximum numbers observed being 1,500, 5,000 and 7,968, respectively. Smaller numbers of harbor seals haul-out at Amak Island, Cape Leontovich, Cape Leiskof, Bear River, and Cape Seniavin. In June 1975, 94.5 percent of the harbor seals observed along the north shore of the Peninsula in the Aleutians East area were present at Izembek/Moffet Lagoons and Port Moller (Frost et al. 1982). Haul-out areas are critical to the maintenance of harbor seal populations within the Aleutians East CRSA because there are a limited number of suitable sites which are used by a large number of harbor seals (BBCMP 1983). Significant haul-out sites for harbor seals in the Aleutians East CRSA are shown on Map F.

In the northern Gulf of Alaska, harbor seals are most commonly found nearshore in water less than three fathoms deep. Harbor seals appear to concentrate in the Shumagin and Sanak Islands and along the coastline of the south Peninsula. Unlike sea lions and sea otters which prefer relatively clear water, harbor seals occupy both clear and turbid waters. The preferred haul-out sites for this species are offshore rocks and sandbars which are briefly exposed during low tide, flat beach areas, and large surf-worn outcrops (Gusey 1978).

Sexual maturity in harbor seals is reached at 5 to 6 years of age. Breeding takes place in late June to July with birth of a single pup occurring each year from May 20 to June 25. Most birth sites are on mudflats or sandbars in estuaries. Newborn pups are able to swim almost immediately after birth and often take to the water before the first high tide following birth. Pups are weaned three or four weeks after birth. Harbor seals generally require certain traditional beaches and offshore rocks for resting and as pupping areas. Land areas where pups are born are particularly important to the welfare of harbor seals and disturbance of these areas should be avoided, especially during the first three weeks in June (Gusey 1978).

Fish, particularly pollock, capelin, Pacific cod, herring, smelt, eulachon, and sand lance are the most frequently occurring food items in the harbor seal diet.

## Bearded, Spotted, Ribbon, and Ringed Seals

The distribution of bearded, spotted, ribbon, and ringed seals in the southern Bering Sea is closely associated with the distribution of sea ice. Bristol Bay is generally considered the southern extent of their ranges. Bearded seals are found on all parts of the pack ice where openings and leads are present, but

Adult male sea otters prefer deep water areas for foraging, while younger animals and pups frequent shallower waters. Competition for food is probably greatest in coastal waters less than 40 m deep. In general, the 80-m isobath is likely the outer limit of sea otter habitat for the population that occupies the area west of Cape Leontovich. Offshore from Port Moller, the 80 m depth contour swings far offshore; in this region, sea otter habitat is probably limited by the seasonal presence of offshore sea ice rather than water depth.

Areas of high-density sea otter population less than 30 m in depth should be considered of critical importance since most reproductive activity, rearing of young, and foraging occurs in these areas (Map F). During periods of extreme environmental stress such as major incursions of sea ice along the northern Alaska Peninsula, open-water habitats are still available in some of these areas to allow survival of healthy adults.

The 1976 aerial survey estimated that approximately 17,000 sea otters were present along the north Peninsula waters of the Aleutians East CRSA. Since the decrease in sea otter population in the early 1970's, formerly occupied habitats to the west of Cape Mordvinof and northeast of Cape Leontovich have not been repopulated. Residents of Cold Bay have observed that the number of sea otters using Izembek Lagoon has declined. These conditions suggest that the current population of sea otters is below a threshold that would encourage range expansion in search of additional food (Schneider 1981).

Sea otters may breed and pup at any time of the year. Breeding activity reaches a peak from September to November, and pupping peaks the following April through June. Sea otter productivity is low with females normally producing one pup every two years after reaching four years of age. The survival of pups is very high when adequate food is available. However, when the population reaches a density at which food becomes a limiting factor, subadult sea otters from nine to twelve months old are the first to be affected by malnutrition (BBCMP 1983). Adult survival remains high and many sea otters attain ages of 15 to 20 years (Gusey 1979).

The diet of sea otters has not been comprehensively examined. Known food items consist of benthic invertebrates such as bivalves, sea urchins, crabs, and octopus. Preliminary results of an ongoing study indicate that sea otters may also feed on yellowfin sole (Thorsteinson 1984).

---

## **CHAPTER 7**

### **Terrestrial Mammals**

---

The most conspicuous mammal species occupying the lands of the Aleutians East CRSA include caribou, moose, and brown bear. Furbearers, including river otter, wolf, wolverine, and red fox also are present throughout the region with limited distribution on offshore islands. Unimak Island, the western limit of the Aleutians East CRSA, has a mammalian fauna similar to that of the contiguous Alaska Peninsula and provides habitat for caribou, brown bear, wolf, wolverine, and red fox. Several species of mammals, including cattle, horses, and foxes, have been introduced to the Aleutians East CRSA and are

bison, and foxes, have been introduced. They are now present in limited numbers (Science Applications, Inc. 1981). Important use areas for terrestrial mammals in the Aleutians East CRSA are identified on Map F. Habitat affinities, seasonal use areas, and life history information for selected mammal species are discussed in the following sections.

## **DISTRIBUTION AND LIFE HISTORY INFORMATION**

### **Caribou**

The Alaska Peninsula caribou herd is present within the Aleutians East CRSA as three subgroups. A herd of 15,000 to 20,000 animals ranges over lowland habitats between King Salmon and Port Moller. The area between Port Moller and Cold Bay supports 6,000 to 8,000 caribou. A small herd of approximately 250 caribou occupies Unimak Island (BBCMP 1984). Some movement of caribou between Unimak Island and the Peninsula across Isanotski Strait, a distance of one-half mile, has been documented since the late 1800's (Gusey 1979).

Caribou differ from other members of the North American deer family since both males and females grow antlers. Female caribou become sexually mature between 1.5 and 3.5 years of age. Mature females weigh 80 to 100 kg and give birth to a single calf each year between late May and early June. Male caribou mature at 1.3 to 2.3 years of age and typically weigh 160 to 180 kg.

Caribou utilize a variety of habitats throughout the year, but spend much of their time in coastal lowlands and upland tundra in the Aleutians East CRSA. The preferred lowland areas are dominated by wet sedge meadows interspersed with heath on drier sites. At higher elevations, heath, willow, alder, and grass communities are used most commonly. Availability of suitable calving areas is an integral part of caribou habitat requirements. Major calving areas in the Aleutians East CRSA are found near Bear River and in the uplands between the Black Hills and the Pavlof Sisters (Map F).

Seasonal occupation of calving grounds is probably the most consistent facet of the somewhat unpredictable movement patterns of caribou herds. Characteristics that distinguish traditional calving areas likely relate to early spring snowmelt, the availability of emergent green vegetation, a wide field of visibility, relatively low densities of predators, and ease of movement. Pregnant female caribou are at their poorest physical condition of the annual cycle just prior to and during calving; the availability of new forage is likely of critical importance to meet the increased energy demands of migration, calving, and lactation.

Calving areas, winter use areas, and migration routes are considered critical habitats for caribou in the Aleutians East CRSA (Map F). Suitable summer use habitats are widely distributed throughout the coastal lowlands and are not generally a limiting factor to the caribou population. The lowlands south of Cold Bay provide an important wintering area for the southern Peninsula caribou herd. In recent years, the herd has increased use of the Aleutian

Range foothills during the winter; however, large numbers of caribou continue to use the "traditional" lowlands of the North Peninsula. During the winter caribou depend on fruticose lichens, grasses, sedges, and low-growing shrubs. Caribou often use different locations in successive years, an apparent adaptation to the slow growth of depleted lichen ranges.

### **Brown Bear**

Terrestrial habitats of the Aleutians East CRSA provide important feeding and denning sites for brown bears. Habitats receiving the most use are the foothills and valleys of the Aleutian Range and coastal areas which are seasonally important as feeding sites. In addition, certain rivers and streams are recognized as areas of concentration for feeding brown bears when salmon are available (Science Applications, Inc. 1981). Izembek National Wildlife Refuge is recognized as an important area of concentration for brown bears during the summer and fall (BBCMP 1983), and Canoe Bay is an important concentration area during the summer (BBCMP 1984). Although historical information on the region's brown bear distribution is not available, it appears that little change has occurred in recent years. Brown bear densities on Unimak Island are probably comparable to those of the lower Alaska Peninsula (Gusey 1979).

Both sexes of brown bears reach maturity at 4.5 to 5.5 years of age. Exceptionally large males may weigh 600 kg, although most are considerably smaller. Mature female brown bears normally weigh only about one-half as much as equivalent-aged males. During the fall, both male and female brown bears weigh 20 to 30 percent more than in the spring. The breeding season extends from May through July, and hairless cubs are born in the maternal den in late January or February. Brown bear litters have from one to three cubs which nurse for two or three summers. The break-up of the female/cub family unit occurs in the spring of the third year when cubs are 2.5 years old. Since females do not give birth to young each year, the productivity of brown bear populations is not high.

Denning of brown bears occurs primarily in the alder-willow zone of the upland coastal habitat. On the Alaska Peninsula, east-facing slopes and well-drained locations are preferred for den sites (Map F). Steep slopes are apparently selected for ease of excavation (Gusey 1979). Denning generally begins in late October and extends through April or into May. Female brown bears and juveniles apparently den earlier in the fall and emerge later in the spring than older male bears. Brown bears descend from denning areas in higher elevations in late May with numbers of bears in coastal areas increasing markedly by early June. Coastal areas provide new vegetation growth and marine mammal carrion for bears to forage. Important early spring foods for brown bears include sedges, grasses, horsetails, and red poque. Since preferred coastal grass flats are relatively limited (Map F), these coastal grass flats are critical brown bear habitat during the spring months. The same grass flats are used year after year to supply a high quality food source to brown bears recently emerged from dens; after the long period of hibernation, bears are at their poorest physical condition of the annual cycle. Carrion, small rodents and caribou and moose calves are also important spring diet items when available (Gusey 1979).

As salmon enter streams in the Aleutians East CRSA in mid-July, brown bears are attracted to this accessible and plentiful food source (Map F). When abundant berries ripen in terrestrial habitats in late August, bears split their feeding activity about equally between fish and berries. By mid-November

abundant berries ripen in terrestrial habitats in late August, bears split their feeding activity about equally between fish and berries. By mid-November, most brown bears have migrated to suitable denning habitat for hibernation (Science Applications, Inc. 1981). Spring use areas and seasonal concentrations along streams are considered critical habitats for the welfare of brown bear populations in the Aleutians East CRSA (Map F).

The long period of food availability into the fall and the abundance and quality of the food, particularly salmon, are responsible for the large size and high population of brown bears in this region (BBCMP 1983). During spring and fall hunting seasons, brown bears are a highly-prized sport hunting trophy with the Alaska Peninsula contributing more than 25 percent of the statewide harvest of brown-grizzly bears since 1961. Within the Aleutians East CRSA, the principal harvest of this species likely occurs in the Bear Lake area east of Port Moller.

## **Moose**

Moose are a relatively new species to inhabit the Alaska Peninsula since they appear to have been rare in this area prior to 1900. The present distribution of moose on the Peninsula extends southwest to Pavlof Bay. The population of moose peaked in this region in the mid-1960's and has since declined. Preferred habitat for moose is primarily limited to the lower slopes and valleys of the Aleutian Range. Riparian shrub communities along major watercourses are the primary moose habitat along the North Peninsula. Survival of moose calves is low (20 calves/100 cows), and predation by brown bears and loss of preferred willow and alder habitat through plant succession are the suspected causes of low recruitment (BBCMP 1983).

In high quality habitats where willow browse is abundant, moose are sexually mature at 1.3 years of age. Mature males weigh 1,000 to 1,600 pounds; females weigh 800 to 1,200 pounds at maturity. Breeding (rutting) takes place from mid-September to mid-October. Calves are born in late May to early June. Up to 90 percent of the female moose over two years of age breed every year. Cows generally give birth to a single calf the first time they breed, but twins are more common in subsequent years if an adequate quantity and quality of forage are available.

Spring/summer use areas and fall use areas are considered important habitats for moose since they support higher densities of animals during certain seasons than the surrounding range land. Because these seasonal use areas also serve as calving areas in the spring and rutting/mating areas in the fall, an absence of noise and disturbance is an important value of these habitats.

Wintering habitat for moose is generally restricted to willow and alder riparian areas along stream floodplains. Winter range is considered critical habitat due to the importance of browse for maintenance of moose populations through the winter months. A critical wintering habitat occurs near Bear Lake in the headwaters of the Bear and King Salmon Rivers (Map F).

## **Furbearers**

Small numbers of wolves range throughout the region feeding on carrion, caribou, moose, and small game. Their relatively low numbers, including a small population on Unimak Island, do not appear related to limitations in

food as there is an abundance of prey available. A widely distributed population of wolverines forages along coastlines and coastal lowlands of the Alaska Peninsula and Unimak Island for carrion, eggs of ground-nesting birds, and berries. More common furbearers of the region include river otter, beaver, mink, short-tailed and least weasel, and red fox.

In addition to their presence in river and stream habitats of the Alaska Peninsula mainland, river otter are present on some islands in the Shumagin group, including Near Island, Turner Island, and Spectacle Islands. River otter trails have been observed on Atkins Island, and residents of Sand Point have trapped otters on Nagai in past years. River otters are known to prey on seabirds, and their presence may have contributed to the disappearance of terns from Range Island in 1978 (Bailey 1978).

### **Introduced Mammals**

Arctic foxes, introduced to most islands of the Aleutians prior to 1930 for fur farming, are still present on many of the islands of the Aleutian Chain and offshore area south of the Alaska Peninsula. The introduction of Arctic fox to Sanak Island led to the elimination of some formerly abundant seabirds on that island, particularly Cassin's Auklets and Ancient Murrelets. Arctic foxes from Attu were introduced to four of the Shumagin Islands around 1900; no nocturnal seabirds presently nest on any of the Shumagins inhabited by foxes. Turner, Bendle, and Spectacle Islands had fox farming operations in the 1920's and 1930's, but no sign of fox presence was noted during 1977 surveys (Bailey 1978). During the same survey in 1977, red foxes appeared to have been eliminated from Popof Island. Red foxes and ground squirrels are indigenous to some of the larger Shumagin Islands as they were recorded on Nagai Island in 1741; however, recent reports indicate that foxes may no longer exist on this island. Fox populations have become established on Deer Island and Outer Iliasik Island, neither of which support seabird colonies. Foxes have disappeared from many of the islands in the Sandman Reefs. This situation has been attributed to trapping, poor winter survival, inbreeding, and a tsunami in 1946 which washed completely over the Sandman Reefs (Bailey and Faust 1980).

Norway rats were introduced to many islands as a result of ship wrecks or military activity during World War II (Sekora et al. 1979). In recent years, there have been attempts to eradicate introduced predators such as foxes from islands where they were historically absent. The purpose of this effort is to preserve the integrity of predator-free islands used by nesting seabirds.

Domestic cattle introduced to Sanak Island have become feral and are currently utilized as a subsistence resource by some residents of False Pass. Feral cattle are also present on some of the Shumagin Islands, in particular Simeonof Island where the U.S. Fish and Wildlife Service has recently arranged to have the cattle removed to reduce overgrazing and to protect seabird resources. In the past, sheep have been grazed on Cherni Island and Sarana Island in the Sandman Reefs area (Bailey and Faust 1980). A small herd of bison introduced to Popof Island by private individuals as a meat source is now protected by the State (City of Sand Point 1981).

---

## **CHAPTER 8**

### **Birds**

## INTRODUCTION

The birdlife of the Aleutians East CRSA is one of its most conspicuous features. The numerous rocks and islands on the south side of the Alaska Peninsula are the sites of dozens of seabird colonies while the lagoons and bays that front the Bering Sea host hundreds of thousands of waterfowl and shorebirds as they migrate to and from nesting grounds along the Arctic coast and the Yukon-Kuskokwim area. The richness of avian life and its importance to the nation, as well as the State, prompted Congress to create three refuges within the Aleutians East CRSA: Izembek, Alaska Peninsula and Alaska Maritime National Wildlife Refuges. Birds represent a significant sport, subsistence, and recreational resource in this part of the State.

For this discussion, birds are divided into four categories: seabirds, shorebirds, waterfowl, and other. Lists of representative species found in the Aleutians CRSA are presented in Tables 8-1 through 8-4. Life histories of selected common species are included in each section.

Map G represents areas of greatest concentration of birds in the Aleutians East CRSA although it is recognized that most species can be found dispersed throughout the region.

## SEABIRDS

The Aleutians East CRSA is the location of some of the most spectacular seabird colonies in the world. Representative species of seabirds found in the area are listed on Table 8-1. Some species such as glaucous-winged gulls, murres, and puffins are year-round residents while others like the Arctic tern migrate to the area in summer to breed. Pelagic species such as the Northern fulmar are found in off-shore areas, but do not form colonies in the Aleutians East CRSA. Seabirds are found primarily in the following coastal habitat types: offshore areas, rocky islands and seacliffs, barrier islands and lagoons, exposed high energy coasts and estuaries. The U.S. Fish and Wildlife Service "Catalog of Alaskan Seabird Colonies" (1978) identifies over 100 colonies between Port Moller and Unimak Pass and Stepovak Bay and Unimak Pass. The majority of these are in the Shumagin, Pavlof, and Sanak Islands and Sandman Reefs, all of which are southeast of the Alaska Peninsula. The Kudobin Islands northeast of Nelson Lagoon support one of the largest colonies on the north side of the Peninsula in this area. It hosts 13,000 glaucous-winged gulls and 1,000 Arctic terns.

Karpa Island, north of Korovin Island, and Castle Rock in the Shumagins are two of the largest colonies in the Aleutians East CRSA. Karpa Island's colony contains an estimated 20,000 murres, 12,000 horned puffins, 10,000 tufted puffins, 5,000 glaucous-winged gulls as well as cormorants, pigeon guillemots, and ancient murrelets. The colony at Castle Rock has an estimated 80,000 tufted puffins, 60,000 horned puffins, 46,000 Cassin's auklets, 30,000 ancient murrelets, 14,000 parakeet auklets, 12,000 Leach's storm petrels, more than 11,000 black-legged kittiwakes, more than 7,000 common murres, as well as fork-tailed storm petrels, thick-billed murres, and

some glaucous-winged gulls, pigeon guillemots, cormorants, and least auklets. The island is a craggy, steep-sided rock covered with tundra and is an essentially predatorless location for the many seabird species which utilize it (Sowls 1978).

**Table 8-1: Seabirds of the Aleutians East CRSA**

Common Names	Scientific Names
Northern fulmar	<i>Fulmarus glacialis</i>
Fork-tailed storm petrel	<i>Oceanodroma furcata</i>
Leach's storm petrel	<i>Oceanodroma leucorhoa</i>
Double-crested cormorant	<i>Phalacrocorax auritus</i>
Pelagic cormorant	<i>Phalacrocorax pelagicus</i>
Red-faced cormorant	<i>Phalacrocorax urile</i>
Glaucous gull	<i>Larus hyperboreus</i>
Glaucous-winged gull	<i>Larus glaucescens</i>
Black-legged kittiwake	<i>Rissa tridactyla</i>
Red-legged kittiwake	<i>Rissa brevirostris</i>
Arctic tern	<i>Sterna paradisaea</i>
Aleutian tern	<i>Sterna aleutica</i>
Common murre	<i>Uria aalge</i>
Thick-billed murre	<i>Uria lomvia</i>
Pigeon guillemot	<i>Cepphus columba</i>
Parakeet auklet	<i>Cyclorhynchus psittacula</i>
Crested auklet	<i>Aethia cristatella</i>
Least auklet	<i>Aethia pusilla</i>
Whiskered auklet	<i>Aethia pygmaea</i>
Horned puffin	<i>Fratercula corniculata</i>
Tufted puffin	<i>Fratercula cirrhata</i>
Black-footed albatross	<i>Diomedea nigripes</i>
Sooty shearwater	<i>Puffinus griseus</i>
Short-tailed shearwater	<i>Puffinus tenuirostris</i>
Pale-footed shearwater	<i>Puffinus carneipes</i>
Herring gull	<i>Larus argentatus</i>
Sabine's gull	<i>Xema sabini</i>
Kittlitz' murrelet	<i>Brachyramphus brevirostris</i>
Ancient murrelet	<i>Synthliboramphus antiquum</i>
Black-headed gull	<i>Larus ridibundis</i>
Bonaparte's gull	<i>Larus philadelphia</i>
Cassin's auklet	<i>Ptychoramphus aleuticus</i>
Rhinoceros auklet	<i>Cerorhinca monocerata</i>
Mew gull	<i>Larus canus</i>
Marbled murrelet	<i>Brachyramphus marmoratus</i>
Laysan albatross	<i>Diomedea immutabilis</i>

Sources: Grinnell (1900), Gabrielson and Lincoln (1959), Sowls (1978)

Several other important colonies and their most numerous species are located at Yukon Harbor (30,000 crested auklets), Hall Island (5,200 tufted puffins, 3,500 parakeet auklets, and 3,000 ancient murrelets), north end of Big Koniugi Island (15,000 black-legged kittiwakes and 4,000 crested auklets), Near Island (20,000 horned puffins), the Twins (11,000 tufted puffins), and Bird Island (43,000 black-legged kittiwakes, 24,000 murrelets, and 16,000 tufted puffins). In the Deer Island-Morzhovoi Bay area the following colonies are significant: Amagat Island (200,000 fork-tailed storm petrels, 140,000 horned puffins, and 100,000 tufted puffins); Unga Island (100,000 Cassin's auklets); High Island (100,000 Leach's storm petrels, 18,000 horned puffins, and 16,000

tufted puffins; and an area of rocks northeast of Hunt Island (100,000 Cassin's auklets, more than 6,000 tufted puffins). All of these colonies contain smaller numbers of other birds such as glaucous-winged gulls and cormorants (Sowls 1978).

The island groups on the south side of the Alaska Peninsula differ considerably from one another. The Shumagins and Semidis are high, rocky islands while the Sandman Reefs are characterized by low, small islands—most are less than 100 feet high and 25 acres in size. Consequently, the habitats appeal to different species of birds. For example, Leach's storm petrel is found to be many times more numerous in the Sandman Reefs than the fork-tailed storm petrel which prefers the rockier habitats.

The population levels of many of these islands have changed dramatically since the turn of the century. In the early 1900's fox farmers utilized islands such as Hunt, High, and Sarana Islands and escaped and released foxes decimated the seabird colonies. Seabirds were virtually absent until 30 or 40 years ago on Hunt and High Islands when the foxes disappeared due to various reasons. Sarana Island still has foxes and, therefore, still has no appreciable populations of seabirds.

Most seabirds are predators, primarily feeding on marine fish and invertebrates such as squid. They often form multi-species feeding flocks that can number more than 5,000 individuals. Seabirds can be divided into two types of feeding groups: surface feeders (fulmars, kittiwakes) and subsurface feeders (auklets, puffins, murres, and shearwaters). Fish species consumed include herring, sandlance and capelin. Some seabirds, such as the gulls and jaegers, are scavengers and often rob other birds' nests of eggs and young.

Gulls, cormorants, and puffins maintain colonies within the Aleutians East CRSA year-round. The overwintering areas of some species are not well known. It is presumed that petrels, fulmars, and kittiwakes winter at sea in the North Pacific area. Arctic terns undertake spectacular migrations to South America each year. Shearwaters breed in Australia, Chile, and New Zealand during the Northern hemisphere's winter months, returning to Alaska during the summer. Here they account for more than 90 percent of the seabirds observed in offshore Alaskan waters from May to September. Shearwaters molt during their presence in Alaska. Aggregations occur in Unimak Pass although shearwaters are generally dispersed throughout the region.

## **Selected Life Histories**

### **GLAUCOUS-WINGED GULL**

The glaucous-winged gull is a common resident of the Gulf of Alaska from the Copper River Delta through Kodiak and the Alaska Peninsula. It prefers nearshore habitats and is frequently found near human settlements. Spring surveys indicate that glaucous-winged and mew gulls comprised over 86 percent of birds observed on sandy beaches from Unimak Pass to Port Heiden along the north side of the Alaska Peninsula. Large colonies are found in the Shumagin Islands, Izembek Lagoon, and Kudobin Islands. Glaucous-winged gulls nest in tundra areas near ponds and lagoons, on river sand bars and on rocky ledges. Nests are bulky conglomerations of moss and other vegetative material.

Since glaucous-winged gulls regularly overwinter in the Aleutians East CRSA, there is no migration as such to the nesting grounds. However, the birds begin to congregate in mid-May to breed and two to three eggs are laid in each nest by early June. Young birds are fledged by mid-August. They retain their dark juvenile feathers for about three years until they gain their adult plumage.

Glaucous-winged gulls are scavengers and feed on anything from garbage to clams and dead salmon. They also rob the nests of other birds, preying on both eggs and young birds.

#### **BLACK-LEGGED KITTIWAKE**

Black-legged kittiwakes are a conspicuous colony nester throughout the Aleutians East CRSA. Colonies are located on rocky islands and cliffs adjacent to the open sea. The birds are noisy and quarrelsome and will aggressively attempt to drive away intruders. Kittiwakes may winter at sea in the North Pacific Ocean from the Aleutians south to the Oregon coast. They return to their colonies in early summer to nest.

Well-constructed nests of vegetation (primarily dried grass and seaweed), debris, and mud are generally located on inaccessible cliffs. Typically, two eggs are laid and are incubated by both parents. Incubation lasts for 28 days and chicks are fed regurgitated food by both parents. Young birds remain in the nest for about 43 days and sometimes return to be fed by the parents even after they have fledged.

Kittiwakes feed on small fish and crustaceans. In the nearby Pribilofs area, black-legged kittiwakes feed primarily on walleye pollock, capelin, and euphausiids. They depart the breeding colonies for wintering grounds in September to mid-October, with young-of-the-year generally leaving before the adults.

#### **MURRES**

Murres found in the Aleutians East CRSA include both the common murre and thick-billed murre. The two birds are extremely similar in appearance and habits. In this area murres do not migrate; however, they may stray considerable distances from their nesting grounds. Murres prefer rocky ledges as nesting areas and are usually present in closely packed aggregations. No nests are built; a single egg is simply laid on a bare rock ledge and is incubated by both parents. Considerable egg loss occurs from eggs falling off ledges and from predation by gulls.

The eggs hatch from late July to mid-August and the parents share the responsibility for feeding the chick. In about 21 days, the chicks leave the nesting ledges. This departure occurs before their feathers have fully developed and the chicks essentially fall from the ledges onto beaches or water below. Mortality is high due to injuries sustained leaving the nest site and from failure of the chicks to become reunited with their parents.

Adult murres feed by diving for small fish and invertebrates. Fish are the most important component, comprising up to 95 percent of the diet. Walleye pollock, capelin, and sand lance are prey species commonly taken by murres.

#### **CORMORANTS**

The double-crested, pelagic, and red-faced cormorants are all found in the

another in the same colony. Cormorants prefer rocky cliffs and islands in the open oceans for their colonies. Of the more than 100 seabird colonies identified for this area, 53 are occupied by cormorants. The largest colonies are found on Wosnesenski Island, Bird Island, Amagof Island, and at Cave Point on Unimak Island. Populations of these colonies range from 1,000 to 6,000 cormorants.

Cormorants are usually resident within their nesting territories. They feed in off-shore waters, diving for small fish. Nests are located on rock ledges within the colonies. Most nests are large grass and mud structures which hold three to six eggs. Eggs hatch in mid- to late June and young cormorants leave the nests about six weeks later. Breeding probably does not occur until the third year after hatching.

### **HORNED PUFFIN**

Horned puffins nest in rock crevices of cliff and bluff areas throughout the Aleutians East CRSA. They are more common on the south side of the Alaska Peninsula than the north. Wintering occurs in the Aleutians area with some birds migrating as far north as Cape Thompson to nest. Horned puffins are often found in colonies with other seabirds. Usually one egg is laid on the bare ground and is incubated for 35 to 40 days. Chicks depart the nest in five to six weeks after hatching. Puffins dive into the sea to catch fish and are adept at "flying" underwater. The horned puffin is more numerous in the Aleutians CRSA than its close relative, the tufted puffin.

## **WATERFOWL**

The area encompassed by the Aleutians East CRSA is one of the most important in the state for waterfowl. Although some breeding does occur in the region, it is more important as a spring and fall staging area for the large numbers of waterfowl that breed in the Yukon-Kuskokwim Delta and areas farther north. It is estimated that 100 percent of the North American population of Emperor geese, brant, spectacled eider, and Steller's eider pass through the area on their way to and from more northerly breeding grounds. More than 50 percent of the populations of Taverner's Canada geese, oldsquaw, and black scoters utilize this region.

Waterfowl prefer habitats such as lagoons, vegetated intertidal zones, and lake margins in contrast to the rocky cliffs inhabited by most seabirds. These preferred habitats are found primarily on the north side of the Alaska Peninsula. Izembek Lagoon is the most outstanding waterfowl use area in the Aleutians East CRSA, followed by the Nelson Lagoon-Port Moller area. Izembek supports a rich growth of eelgrass, the principal food of brant and an important food item for other waterfowl. Other bays and lagoons with vegetated intertidal areas on the south side of the Peninsula are also exploited by waterfowl, including Morzhovoi Bay. Tundra swans are the major nesting species on the Alaska Peninsula portion of the Aleutians East CRSA. Waterfowl also nest throughout the Sandman Reefs and other islands utilizing ponds and grassy beach areas.

The spring migration of waterfowl is somewhat less defined than the fall migration. Waterfowl tend to pass through the area in groups that spend relatively little time within the Aleutians East CRSA. Unimak Pass and Izembek Lagoon are important portals to the Bering Sea nesting areas. Birds tend to fly a more or less direct route to their nesting grounds.

---

**Table 8-2: Waterfowl of the Aleutians East CRSA**

Common Name	Scientific Name
Oldsquaw	<i>Clangula hyemalis</i>
Harlequin duck	<i>Histrionicus histrionicus</i>
Common eider	<i>Somateria mollissima</i>
Red-breasted merganser	<i>Mergus serrator</i>
White-winged scoter	<i>Melanitta fusca</i>
Green-winged teal	<i>Anas crecca</i>
Mallard	<i>Anas platyrhynchos</i>
Greater scaup	<i>Aythya marila</i>
Gadwall	<i>Anas strepera</i>
Tundra swan	<i>Cygnus columbiana</i>
Cackling Canada goose	<i>Branta canadensis minima</i>
Taverner's Canada goose	<i>Branta canadensis taverneri</i>
White-fronted goose	<i>Anser albifrons</i>
Brant	<i>Branta bernicle</i>
Emperor goose	<i>Philacte canagica</i>
Pintail	<i>Anas acuta</i>
King eider	<i>Somateria spectabilis</i>
Spectacled eider	<i>Somateria fischeri</i>
Steller's eider	<i>Polysticta stelleri</i>
Black scoter	<i>Melanitta nigra</i>
Surf scoter	<i>Melanitta perspicillata</i>
American wigeon	<i>Anas americana</i>
Northern shoveler	<i>Anas clypeata</i>
Bufflehead	<i>Bucephala albeola</i>
Barrow's goldeneye	<i>Bucephala islandica</i>
Common goldeneye	<i>Bucephala clangula</i>
Common loon	<i>Gavia immer</i>
Arctic loon	<i>Gavia arctica</i>

Sources: Grinnell (1900), Gabrielson and Lincoln (1959), Bellrose (1976)

---

In April, migrant waterfowl begin arriving on the Alaska Peninsula. Pintails, king eiders, brant, and emperor geese are among the first arrivals. Izembek Bay and other nearby lagoons are particularly important at this time. The birds rest and feed here until their more northerly nesting areas are ice-free, usually late April and early May.

After nesting is complete, ducks, geese, and swans begin gradually moving from nesting grounds to the Alaska Peninsula. The birds tend to fly a coastal route utilizing bays and lagoons along Bristol Bay and the Alaska Peninsula. Ducks experience a more diffuse migration in the fall than in the spring although pintails and scoters generally exhibit large concentrations in both seasons. The adult males begin their molt in early July with females and their young molting later in July. During the molt waterfowl lose their primary wing feathers and cannot fly. In August, waterfowl begin to congregate for their southward migrations. Brant and emperor geese are found in lagoons along the Alaska Peninsula westward to False Pass with Izembek Lagoon being the largest area of concentration. Steller's eiders molt in Nelson and Izembek Lagoons during August and September. Both "dabbling" and diving ducks utilize lagoons and intertidal areas in the Aleutians East CRSA during fall migration.

Most of the species which migrate through this area winter along the Pacific coast from Washington to California. Some, like king eiders and emperor geese, overwinter in the Aleutians. Mallards, present during the winter in reduced numbers, will exploit nearly any ice-free waterbody for overwintering. Green-winged teal are also found in reduced numbers in the Aleutians East CRSA during winter months.

Geese and swans primarily feed on vegetation in shallow waters both in freshwater and brackish water areas. Ducks can be divided into two groups: dabbling ducks and diving ducks. Dabbling ducks, such as the mallard, pintail, gadwall, shoveler, and green-winged teal, also feed on vegetation in shallow waters. They are especially fond of eelgrass seed during the fall months. Scaup, eiders, harlequins, and scoters are diving ducks which feed on small fish, crustaceans, and molluscs. These birds are more often found in marine waters than the dabbling ducks.

## **Selected Life Histories**

### **BRANT**

Brant breed along the northwest coast of Alaska from the Kuskokwim Delta north. Mating usually occurs before the birds reach the nesting grounds. Nests are located in marshy areas and are usually a depression lined with grass and down. Brant lay three to eight eggs which hatch in late June.

The principal foods of brant are eelgrass and sea lettuce; brant are highly dependent upon this very specific food source. Diatoms, shrimp, bryozoans, and other animal matter are ingested incidentally during feeding. Brant are highly dependent upon this very specific food source.

During spring and fall migrations, brant stay well off-shore, more than other species of geese. The birds begin to gather for their southward flight in August. Izembek Lagoon is the single most important fall staging area in the world for brant with nearly the entire population passing through this area. Birds begin to arrive in August with the peak occurrence in September and October. By the end of November the birds have departed. Brant winter from Washington to Mexico with over 90 percent wintering in Baja California.

### **CAKCLING CANADA GEESE AND TAVERNER'S CANADA GEESE**

Taverner's and cackling Canada geese are two of the most common types of waterfowl on the Alaska Peninsula in the fall. Cackling geese are the smallest subspecies of Canada goose, weighing only three or four pounds compared to weights up to 18 pounds for other subspecies. They arrive in the Aleutians East CRSA in early May. The majority of the population nests in the Yukon-Kuskokwim area. The Aleutians East CRSA serves mainly as a staging area for the cackling goose in the fall, although some nesting may have occurred here historically. The entire Alaskan population rests in the Bristol Bay area before heading south to overwinter in central California. Although Ugashik Lakes are the primary staging areas for cacklers, Izembek Lagoon does host some of these geese. Approximately 70,000 of the estimated total population of 100,000 Taverner's geese stage at Izembek Lagoon. Their fall migration brings them into the Aleutians East CRSA in greater numbers than their more northerly spring migration.

Cackling geese nest close to salt water, while Taverner's geese usually nest further inland. Both are among the earliest spring nesters with eggs being laid in early May. Young birds fledge in about 40 days for cacklers and up to 60 for Taverner's. Principal foods consist of seeds, roots and stems of rushes, and grasses and other plants. Eelgrass and crowberries are important fall foods.

#### **EMPEROR GEESE**

Emperor geese are found in lagoons and brackish water areas from Kotzebue to the Aleutian Islands. They are not usually associated with freshwater except where lakes and ponds are located close to the coast. The emperor goose breeds primarily along the Seward Peninsula and Kuskokwim River Delta; some breeding may occur within the Aleutians East CRSA.

Emperor geese winter along the Aleutians and the Alaska Peninsula. They are abundant in the Port Moller to Unimak Island area, particularly during September and October, although they may arrive at Izembek Lagoon and Cold Bay as early as mid-August.

Emperor geese migrate eastward along the Aleutians in the spring. They congregate in Izembek Lagoon and Port Moller. Here pairing and copulation take place so that nesting begins almost immediately upon reaching the Yukon-Kuskokwim area. Nests are usually located in salt marshes and are lined with moss, grass, or down. Although five or six eggs per nest are most common, as many as eleven eggs may be laid. Incubation begins in early June and eggs hatch by late June or early July. Geese feed on eelgrass, crowberries, and a variety of invertebrates including mussels.

#### **TUNDRA SWAN**

The tundra swan population of the Aleutians East CRSA is made up of three segments: those that migrate through the area, those that migrate to the area to nest, and those that remain in the area year-round. Swans move through the region in April and May on their way to nesting grounds in the Yukon-Kuskokwim Delta, Kotzebue Sound and northern Alaska Peninsula. In the fall, they move south along the Alaska Peninsula to overwinter from Washington to California. Some of these migrants remain in the Aleutians East CRSA to nest and then move south in the fall.

The Aleutians East CRSA is unique in that it contains a resident population of tundra swans. This population, which numbers about 800 individuals, nests and overwinters in the region. Overwintering locations appear to be dependent upon the severity of the winter. Peterson Lagoon on Unimak Island is used for overwintering during cold winters, whereas the swans tend to disperse to other Unimak lagoons and areas north of Morzhovoi Bay during less inclement weather. Nesting for all three segments of the tundra swan population occurs at Morzhovoi Bay, Ikatan Flats, Swanson Lagoon, King Cove and Port Moller.

Adult swans usually mate for life. Islands or peninsulas in lakes and hummocks in wet tundra areas are preferred nest sites. Nests are 12 to 18 inches high and composed of vegetation such as moss, grass and sedges. Nesting begins in late April and peaks in May with hatching occurring 31 to 33 days later. The male and female take turns incubating the eggs. The peak of the hatch occurs in early June and the cygnets fledge 60 to 75 days later. During this time, the young will have grown from 6 ounces to 12-14 pounds. Molting for adults begins around mid-July and by mid-August the swans are flying again. In breeding pairs, females with young often molt first, although flightless periods for the male and female may overlap. Fall migration begins in September and continues into October.

Swans feed on stems, roots and tubers of aquatic vegetation found in

Birds have paired before arriving at the nesting grounds. Nests are located near small lakes and ponds, although some nests have been located as far as 400 yards from the nearest waterbody. A depression in the ground lined with grass and down constitutes the nest. Eight or nine eggs are laid and the ducklings hatch after an incubation period of 23 to 25 days; fledging occurs in 37 to 44 days. Drakes leave the hens after incubation begins and return to marsh areas where they undergo molt. Hens molt after their broods have hatched. The molt lasts 35 days.

Fall migration begins as early as mid-August and continues until November. Wigeons feed on eelgrass seeds and other brackish water plants in coastal areas. Inland they feed on various pondweeds and algae. In contrast to mallards and pintails, wigeons prefer the stems and leaves of freshwater plants to seeds and roots.

## SHOREBIRDS

Shorebirds move into the intertidal areas along the Alaska Peninsula and Unimak Island in early spring when those areas become ice-free. Most shorebirds which move into this area have wintered in Kachemak Bay, Copper River Delta, and the Pacific Northwest. The birds usually gather in the mouths of major rivers which are the first areas to thaw. They may stay in these locations for several weeks before moving to their breeding grounds. The major breeding ground in western Alaska is the Yukon-Kuskokwim River Deltas.

Shorebirds remain on their nesting grounds during May and June. In July and August, post-breeding birds congregate in intertidal areas, such as the lagoons on the Alaska Peninsula, to forage and to molt. Fall surveys indicate that shorebirds account for over 70 percent of birds observed on exposed sandy beaches along the north side of the Alaska Peninsula.

Nelson Lagoon and Izembek Lagoon are the two most important shorebird use areas. Western sandpipers are among the first post-breeders to arrive in the intertidal areas and are present after late July. Dunlins, which are even more numerous, begin to arrive in September. Rock sandpipers also form huge flocks in late summer and fall. The highest density of shorebirds in Nelson Lagoon occurs in late September and early October. The birds remain in the foraging areas for several weeks before departing for overwintering grounds further south. By mid-October virtually all shorebirds have departed.

Along the Alaska Peninsula some wintering occurs in ice-free areas. During this season rock sandpipers can be found in rocky and gravelly areas while sanderlings utilize sandy or muddy substrates.

### Selected Life Histories

#### DUNLIN

Dunlin are one of the most common shorebirds in western Alaska. They arrive in Alaska in early May to breed in intertidal areas throughout the Aleutians East CRSA. Although dunlin may be found on beaches, they prefer mudflats and wet marshes. Nests are placed on drier spots within the wetland habitat and eggs are laid by late May to early June. Adult males leave the breeding grounds in mid-June and congregate in adjacent intertidal habitat to feed on insects and crustaceans and to molt. Females join the males later in the season. Dunlin remain in the area through the fall.

insects and crustaceans and to molt. Females join the males later in the season. Dunlin remain in the intertidal areas into early October before departing for wintering areas from Washington to central California.

### WESTERN SANDPIPER

Although the largest breeding concentration of western sandpipers is found on the Yukon Delta, they do breed throughout the Aleutians East CRSA. Western sandpipers return to Alaska in May, arriving in the state in small groups. Nests are located in drier tundra areas and consist of a small depression lined with leaves and grass. Usually four eggs per nest are incubated for 18 or 19 days. Most eggs hatch by late June. In mid-July, female sandpipers leave the nest to congregate on intertidal areas. They are followed by the males and then the juveniles. Large flocks of western sandpipers can be observed along beaches and in lagoons in August and September. Western sandpipers feed on insects and small molluscs and forage in conspicuous groups. Most birds have departed for wintering areas from California to South America by late September.

**Table 8-3: Shorebirds of the Aleutians East CRSA**

Common Name	Scientific Name
Semi-palmated plover	<i>Charadris semipalmatus</i>
American golden plover	<i>Pluvialis dominica</i>
Black-bellied plover	<i>Pluvialis squatarola</i>
Hudsonian godwit	<i>Limosa haemastica</i>
Bar-tailed godwit	<i>Limosa lapponica</i>
Whimbrel	<i>Numenius phaeopus</i>
Bristle-thighed curlew	<i>Numenius tahitiensis</i>
Greater yellowlegs	<i>Tringa melanoleuca</i>
Lesser yellowlegs	<i>Tringa flavipes</i>
Wandering tattler	<i>Heteroscelus incanus</i>
Ruddy turnstone	<i>Arenaria interpres</i>
Black turnstone	<i>Arenaria melanocephala</i>
Northern phalarope	<i>Phalaropus lobatus</i>
Red phalarope	<i>Phalaropus fulicaria</i>
Common snipe	<i>Gallinago gallinago</i>
Short-billed dowitcher	<i>Limnodromus griseus</i>
Longbilled dowitcher	<i>Limnodromus scolopaceus</i>
Surfbird	<i>Aphriza virgata</i>
Red knot	<i>Calidris canutus</i>
Sanderling	<i>Calidris alba</i>
Semipalmated sandpiper	<i>Calidris pusilla</i>
Western sandpiper	<i>Calidris mauri</i>
Rufous-necked sandpiper	<i>Calidris ruficollis</i>
Least sandpiper	<i>Calidris minutilla</i>
Baird's sandpiper	<i>Calidris bairdi</i>
Pectoral sandpiper	<i>Calidris melanotos</i>
Sharp-tailed sandpiper	<i>Calidris acuminata</i>
Rock sandpiper	<i>Calidris ptilocnemis</i>
Dunlin	<i>Calidris alpina</i>
Buff-breasted sandpiper	<i>Tryngites subruficollis</i>
Black oystercatcher	<i>Haematopus bachmani</i>

Sources: Grinnell (1900), Gabrielson and Lincoln (1959)

Birds have paired before arriving at the nesting grounds. Nests are located near small lakes and ponds, although some nests have been located as far as 400 yards from the nearest waterbody. A depression in the ground lined with grass and down constitutes the nest. Eight or nine eggs are laid and the ducklings hatch after an incubation period of 23 to 25 days; fledging occurs in 37 to 44 days. Drakes leave the hens after incubation begins and return to marsh areas where they undergo molt. Hens molt after their broods have hatched. The molt lasts 35 days.

Fall migration begins as early as mid-August and continues until November. Wigeons feed on eelgrass seeds and other brackish water plants in coastal areas. Inland they feed on various pondweeds and algae. In contrast to mallards and pintails, wigeons prefer the stems and leaves of freshwater plants to seeds and roots.

## SHOREBIRDS

Shorebirds move into the intertidal areas along the Alaska Peninsula and Unimak Island in early spring when those areas become ice-free. Most shorebirds which move into this area have wintered in Kachemak Bay, Copper River Delta, and the Pacific Northwest. The birds usually gather in the mouths of major rivers which are the first areas to thaw. They may stay in these locations for several weeks before moving to their breeding grounds. The major breeding ground in western Alaska is the Yukon-Kuskokwim River Deltas.

Shorebirds remain on their nesting grounds during May and June. In July and August, post-breeding birds congregate in intertidal areas, such as the lagoons on the Alaska Peninsula, to forage and to molt. Fall surveys indicate that shorebirds account for over 70 percent of birds observed on exposed sandy beaches along the north side of the Alaska Peninsula.

Nelson Lagoon and Izembek Lagoon are the two most important shorebird use areas. Western sandpipers are among the first post-breeders to arrive in the intertidal areas and are present after late July. Dunlins, which are even more numerous, begin to arrive in September. Rock sandpipers also form huge flocks in late summer and fall. The highest density of shorebirds in Nelson Lagoon occurs in late September and early October. The birds remain in the foraging areas for several weeks before departing for overwintering grounds further south. By mid-October virtually all shorebirds have departed.

Along the Alaska Peninsula some wintering occurs in ice-free areas. During this season rock sandpipers can be found in rocky and gravelly areas while sanderlings utilize sandy or muddy substrates.

### Selected Life Histories

#### DUNLIN

Dunlin are one of the most common shorebirds in western Alaska. They arrive in Alaska in early May to breed in intertidal areas throughout the Aleutians East CRSA. Although dunlin may be found on beaches, they prefer mudflats and wet marshes. Nests are placed on drier spots within the wetland habitat and eggs are laid by late May to early June. Adult males leave the breeding grounds in mid-June and congregate in adjacent intertidal habitat to feed on insects and crustaceans and to molt. Females join the males later in the season. Dunlin remain in the intertidal areas into early October before departing for wintering areas from Washington to central California.

## WESTERN SANDPIPER

Although the largest breeding concentration of western sandpipers is found on the Yukon Delta, they do breed throughout the Aleutians East CRSA. Western sandpipers return to Alaska in May, arriving in the state in small groups. Nests are located in drier tundra areas and consist of a small depression lined with leaves and grass. Usually four eggs per nest are incubated for 18 or 19 days. Most eggs hatch by late June. In mid-July, female sandpipers leave the nest to congregate on intertidal areas. They are followed by the males and then the juveniles. Large flocks of western sandpipers can be observed along beaches and in lagoons in August and September. Western sandpipers feed on insects and small molluscs and forage in conspicuous groups. Most birds have departed for wintering areas from California to South America by late September.

**Table 8-3: Shorebirds of the Aleutians East CRSA**

Common Name	Scientific Name
Semi-palmated plover	<i>Charadris semipalmatus</i>
American golden plover	<i>Pluvialis dominica</i>
Black-bellied plover	<i>Pluvialis squatarola</i>
Hudsonian godwit	<i>Limosa haemastica</i>
Bar-tailed godwit	<i>Limosa lapponica</i>
Whimbrel	<i>Numenius phaeopus</i>
Bristle-thighed curlew	<i>Numenius tahitiensis</i>
Greater yellowlegs	<i>Tringa melanoleuca</i>
Lesser yellowlegs	<i>Tringa flavipes</i>
Wandering tattler	<i>Heteroscelus incanus</i>
Ruddy turnstone	<i>Arenaria interpres</i>
Black turnstone	<i>Arenaria melanocephala</i>
Northern phalarope	<i>Phalaropus lobatus</i>
Red phalarope	<i>Phalaropus fulicaria</i>
Common snipe	<i>Gallinago gallinago</i>
Short-billed dowitcher	<i>Limnodromus griseus</i>
Longbilled dowitcher	<i>Limnodromus scolopaceus</i>
Surfbird	<i>Aphriza virgata</i>
Red knot	<i>Calidris canutus</i>
Sanderling	<i>Calidris alba</i>
Semipalmated sandpiper	<i>Calidris pusilla</i>
Western sandpiper	<i>Calidris mauri</i>
Rufous-necked sandpiper	<i>Calidris ruficollis</i>
Least sandpiper	<i>Calidris minutilla</i>
Baird's sandpiper	<i>Calidris bairdi</i>
Pectoral sandpiper	<i>Calidris melanotos</i>
Sharp-tailed sandpiper	<i>Calidris acuminata</i>
Rock sandpiper	<i>Calidris ptilocnemis</i>
Dunlin	<i>Calidris alpina</i>
Buff-breasted sandpiper	<i>Tryngites subruficollis</i>
Black oystercatcher	<i>Haematopus bachmani</i>

Sources: Grinnell (1900), Gabrielson and Lincoln (1959)

## OTHER BIRDS

In addition to waterfowl, seabirds, and shorebirds, the Aleutians East CRSA is host to a variety of raptors, other birds of prey, and passerines (song birds). The species list presented in Table 8-4 identifies some of the more common species.

The bald eagle and the raven are considered by some to be the most conspicuous land birds of the Alaskan coast. Bald eagles nest throughout the Aleutian Islands and Alaska Peninsula, overwintering primarily in southeastern Alaska, although some overwintering does occur within the Aleutians East CRSA. Ravens are present throughout the year. In this area, eagles feed chiefly on seabirds and carcasses of spawned out salmon whereas ravens are primarily carrion feeders and frequent of town garbage dumps.

Another important bird in this region is the sandhill crane which moves into the area during the spring and fall migrations. Some cranes remain through the summer to breed in the Aleutians East CRSA. Ptarmigan are common throughout the peninsula year-round and are harvested by subsistence and sport hunters.

### Selected Life Histories

#### PEREGRINE FALCON

Peale's peregrine falcon, the subspecies found in the Aleutians and on the Alaska Peninsula, is not considered to be endangered. The bird exploits habitats similar to its northern cousin, i.e./rocky cliff areas and is associated very closely with the coastal cliffs and bluffs. The falcon is a voracious and efficient predator, feeding on gulls, grouse, shorebirds, waterfowl, passerines and other birds. Peregrines take their prey "on the wing," often reaching speeds in excess of 100 miles per hour as they dive toward their prey.

Nests are usually on rocky ledges or cliffs and are rude collections of soil and debris scratched together. Three or four eggs are laid and chicks fledge at about five weeks. Breeding occurs along the Aleutian Islands and Alaskan coast to British Columbia. The peregrine winters primarily from British Columbia to southern California.

#### SANDHILL CRANE

The sandhill crane breeds throughout the Aleutians East CRSA. Its wintering areas include southern California and Baja California, Texas, and Mexico. The birds begin to arrive in Alaska in late April and early May. Although sandhill cranes are dispersed over their breeding grounds, their migrations are very conspicuous since they gather in large flocks which circle slowly over marsh areas. This is characteristic of both the fall and spring migrations although it occurs more frequently in the spring.

Cranes indulge in unique mating dances. Nesting occurs in marshes or marshy tundra areas. The nest is a depression on the ground lined with dry grass and feathers. Two eggs are laid and chicks are precocious, being able to run very well when only a few days old. Sandhill cranes eat a variety of insects, small animals, seeds, roots, and bulbs. The fall migration begins in late August and early September. By October most cranes are well on their way to their southerly wintering grounds.

---

**Table 8-4: Representative raptors, corvids, and passerines of the Aleutians East CRSA**

Common Name	Scientific Name
Peregrine falcon	<i>Falco peregrinus</i>
Pomarine jaeger	<i>Stercorarius pomarinus</i>
Parasitic jaeger	<i>Stercorarius parasiticus</i>
Long-tailed jaeger	<i>Stercorarius longicaudus</i>
Willow ptarmigan	<i>Lagopus lagopus</i>
Rock ptarmigan	<i>Lagopus mutus</i>
Sandhill crane	<i>Grus canadensis</i>
Bald eagle	<i>Haliaeetus leucocephalus</i>
Goshawk	<i>Accipiter gentilis</i>
Rough-legged hawk	<i>Buteo lagopus</i>
Golden eagle	<i>Aquila chrysaetos</i>
Northern harrier	<i>Circus cyaneus</i>
Gyr falcon	<i>Falco rusticolus</i>
Great horned owl	<i>Bubo virginianus</i>
Snowy owl	<i>Nyctea scandiaca</i>
Hawk owl	<i>Surnia ulula</i>
Short-eared owl	<i>Asio flammeus</i>
Boreal owl	<i>Aegolius funereus</i>
Gray jay	<i>Perisoreus canadensis</i>
Golden-crowned sparrow	<i>Zonotrichia atricapilla</i>
Savannah sparrow	<i>Passerculus sandwichensis</i>
Black-billed magpie	<i>Pica pica</i>
Common raven	<i>Corvus corax</i>
Black-capped chickadee	<i>Parus atricapillus</i>
Boreal chickadee	<i>Parus hudsonicus</i>
Lapland longspur	<i>Calcarius lapponicus</i>
Snow bunting	<i>Plectrophenax nivalis</i>
Fox sparrow	<i>Passerella iliaca</i>
Song sparrow	<i>Melospiza melodia</i>
American robin	<i>Turdus migratorius</i>
Dipper	<i>Circus mexicanus</i>
Common redpoll	<i>Carduelis flammea</i>
Wilson's warbler	<i>Wilsonia pusilla</i>
Yellow warbler	<i>Dendroica petechia</i>
Gray-crowned rosy finch	<i>Leucosticte tephrocotis</i>
Winter wren	<i>Troglodytes troglodytes</i>

Sources: Grinnell (1900), Gablelson and Lincoln (1959)

# **SECTION III: Commercial Fish**

## **INTRODUCTION**

The Aleutians East CRSA economy and way of life centers on commercial fishing, and its importance to the Region cannot be overstated. Almost all residents are involved in the fishing industry either as fishermen, processing workers, or in providing services to these basic industry sectors.

The Aleutians East CRSA commercial fisheries are large and diverse and the potential exists for further diversification and expansion. In 1982, the commercial catch coming from waters off the Aleutians East CRSA totaled 495 million pounds and consisted of:

56.8 million pounds of salmon worth \$36.7 million to fishermen and \$107.2 million at the wholesale level

2.5 million pounds of herring worth \$419,500 to fishermen and \$1.5 million at the wholesale level

1.6 million pounds of king crab worth \$5.4 million to fishermen from South Peninsula waters; and 3 million pounds worth \$9 million to fishermen from Bristol Bay waters

4.6 million pounds of tanner crab worth \$4.8 million to fishermen from South Peninsula waters; plus a portion of the 34.2 million pound Bering Sea harvest that was worth over \$36.7 million to fishermen

0.5 million pounds of Dungeness crab worth \$402,000 to fishermen

125.2 million pounds of groundfish from Gulf of Alaska waters south of the Aleutians East CRSA; and much of the 269.2 million pounds of joint-venture and domestic Bering Sea groundfish harvest.

## **HARVESTING SECTOR**

The complementary salmon and crab fisheries have supported the Aleutians East CRSA's commercial fishing economy throughout the last decade. During the early and mid-1970's when salmon stocks were depressed, king and tanner crab became important fisheries. In the late 1970's and 1980's as salmon stocks and catches reached record highs, traditional crab fisheries declined. Other fisheries, such as halibut and Dungeness crab are best viewed as supplemental fisheries in the Aleutians East CRSA and local participation in them depends in large part on success in the more traditional fisheries. The area's rich groundfish fishery remains dominated by foreign fishermen, although domestic harvesters from outside the Aleutians East CRSA have made impressive gains in utilizing the resource during the last several years. Interest in expanding local participation in the Dungeness crab, halibut, and groundfish fisheries is currently increasing.

Commercial fishing occurs throughout the year in Aleutians East CRSA waters (Table III-1). Most local activity is concentrated during the summer salmon season and the fall and winter crab seasons. Important fishing grounds for the commercially utilized fish and shellfish species found in the Aleutians East CRSA area are illustrated in Maps H and I. It must be emphasized that these maps show generalized locations and that specific important fishing grounds change from year to year and, in some cases, from day to day.

The Aleutians East CRSA fishing fleet is modern, large, and diverse. Much of the fleet was upgraded during the late 1970's and early 1980's, especially the larger seine boats. Almost all large boats owned by Aleutians East CRSA residents are 58 feet overall length or less, 58 feet being the longest boat allowed to participate in the salmon seine fishery. These large seine boats, called limit seiners, also participate in South Peninsula king and tanner crab fisheries. Sand Point and King Cove are home ports to most Aleutians East CRSA limit seiners. There are also many medium-sized vessels (21 to 42 feet) that are primarily used for drift gillnetting in the salmon fishery but may also be used for halibut fishing and the Port Moller roe herring fishery. Large numbers of small skiffs (less than 21 feet in length) are found in all Aleutians East CRSA villages which are used both for commercial fishing (set gillnetting, hand seining) and other purposes.

In addition to vessels that belong to Aleutians East CRSA residents, a large variety of other, mostly larger, fishing vessels are found in the Aleutians East CRSA vicinity throughout the year. Domestic crabber/trawler vessels greater than 100 feet in length fish the Bering Sea waters to the north of the Aleutians East CRSA throughout the year. Some of these vessels dock in Sand Point on their way to and from the fishing grounds. Foreign fishing vessels are found in Gulf of Alaska waters south of the Aleutians East CRSA throughout the year. While their activity is restricted to offshore waters, they often move inshore to designated offloading areas and periodically to designated refuges during storms (Map I).

## **SEAFOOD PROCESSING**

The seafood processing industry in the Aleutians East CRSA is a major component of the region's economy. Fish and shellfish are processed onshore at major facilities in King Cove, Sand Point, and Port Moller, as well as at a small facility in Cold Bay, and by floating processors that enter the area during salmon season. In addition, onshore fish buying and service facilities are located in False Pass and Sand Point. The location of processors is shown on Map H and the activities of the onshore processors and service stations are summarized in Table III-2.

The seafood processing sector, like the harvesting sector, follows an annual pattern of activity. Processing activity is greatest during the summer salmon season. Only the Peter Pan Seafoods facility in King Cove and the Aleutian Cold Storage facility in Sand Point usually operate year-round, processing a variety of species, although both plants shut down operations during the fall and early winter of 1983-84 due to closures in the king crab fishery.

Significant employment is generated by the fish processing sector, especially during the summer salmon season. Participation by Aleutians East CRSA residents in seafood processing jobs is, however, limited and is largely restricted to women and young adults. The majority of processing workers are from the Seattle area and are seasonally housed at the processing facility in bunkhouses. During the winter, when overall employment levels are low, relatively more Aleutians East CRSA residents work in both the King Cove and Sand Point seafood processing plants.

Nearly all salmon produced in the Aleutians East CRSA is canned or frozen. Very limited quantities of fresh salmon are flown from Cold Bay directly to Japan and the continental United States. Other species are frozen and exported from the region. Most processed product is either shipped directly to Japan via Japanese freighters or barged by regularly scheduled marine transportation to Seattle where it is distributed to its final market. Small quantities of shellfish are flown directly from Cold Bay to Japan.

**Table III-1: Timing of major commercial fisheries in Aleutians East CRSA waters**

Commercial Fishery	Month											
	J	F	M	A	M	J	J	A	S	O	N	D
Salmon						■	■	■	■			
Herring	■	■				■						■
Halibut					■	■		■				
King Crab <sup>1</sup>										■		
Tanner Crab		■	■									
Dungeness Crab								■	■	■	■	■
Groundfish	■	■	■	■	■	■	■	■	■	■	■	■

<sup>1</sup>The 1983 king crab season was canceled

**Table III-2: Seafood processing facilities and service stations in the Aleutians East CRSA**

Processor	Location	Facilities	Species	Products	Employees	Other Services
Peter Pan Seafoods <sup>1</sup>	King Cove <sup>2</sup>	7 can lines freezer cold storage	salmon king crab tanner crab halibut herring	canned and frozen salmon frozen crab frozen halibut frozen herring	25 local 260 non-local	fuel, gear, groceries, machine shop, incoming freight
	False Pass	service center <sup>3</sup>	salmon	—	7	fuel, gear, groceries, parts, maintenance
	Sand Point	service center	salmon	—	1 local 9 non-local	gear, storage lockers, parts, small boat haul-out
	Port Moller <sup>2</sup>	freezer cold storage	salmon herring	frozen salmon frozen herring	120 non-local	fuel, gear, groceries, parts, boat storage
Aleutian Cold Storage	Sand Point	freezer cold storage	salmon crab halibut herring	frozen salmon frozen crab frozen halibut frozen herring	20 local 100 non-local	fuel, dock services, electricity
Winky's Peninsula Seafoods	Cold Bay	freezer cold storage	salmon crab	fresh/frozen salmon live hair crab	2	none

<sup>1</sup>Peter Pan Seafoods, Inc. also has a facility in Squaw Harbor that was used primarily for shrimp processing from 1969-79, then was closed down. In 1981 and 1982 it was leased to Jangaard, Inc. who used it to produce salt cod. In 1983 the plant did not operate.

<sup>2</sup>These facilities usually also process salmon caught in Bristol Bay.

<sup>3</sup>There was a cannery in False Pass until 1981 when it burned. There are currently no plans to rebuild a cannery in this location.

Sources: R. Davis and R. Tullis, Peter Pan Seafoods, Inc., personal communication; R. Galovin, Aleutian Cold Storage, personal communication; W. Crawford, Winky's Peninsula Seafoods, personal communication; Langdon and Tobolsky 1982

## CHAPTER 9

### Salmon Fisheries

The commercial salmon fisheries of the Aleutians East CRSA are of tremendous economic importance to the area's residents. All five species of salmon are harvested, although pinks, reds and chums are most important. Fishing occurs from June through September in different parts of the region. Purse seines and drift gillnets take the largest proportion of the catch, although set gillnets continue to be used in several areas.

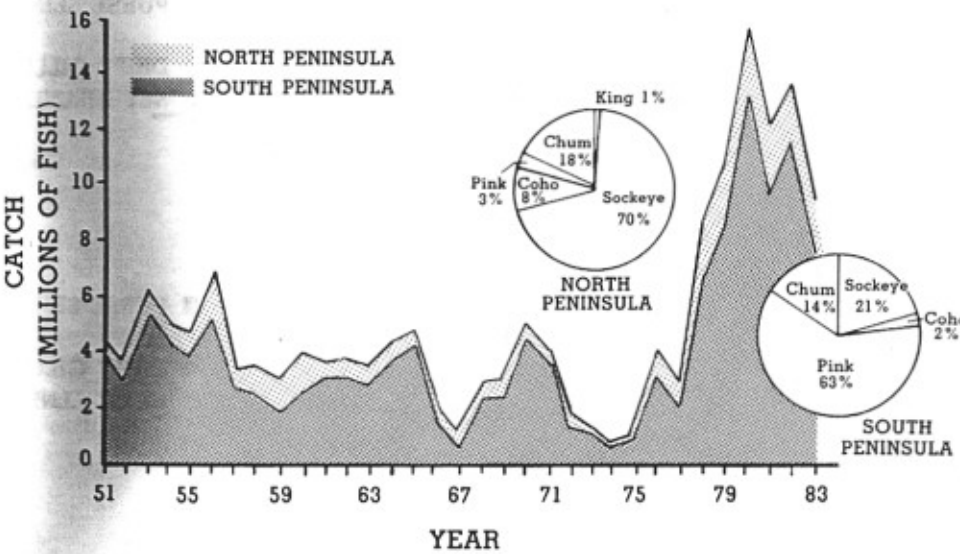
#### CATCH

The Alaska Peninsula Salmon Management Area encompasses the Aleutians East CRSA and also includes a limited area to the northeast (east along the Alaska Peninsula to Cape Menshikof). Commercial Fishing Districts are shown on Map H. Catch data reported in this profile for the North Peninsula include catches from the area outside the Aleutians East CRSA. The South Peninsula Fishing District lies entirely within the Aleutians East CRSA. While Aleutians East CRSA residents also fish in the Unalaska vicinity for pink salmon, data from this fishery are not included here.

The commercial salmon harvest from Alaska Peninsula waters has averaged about 13 million fish per year during the last five years. This is a tremendous increase from pre-1976 catches when catches throughout western Alaska were extremely depressed (Figure 9-1). The increases have resulted from combined increases in effort, gear efficiency (especially the increased use of seine gear), and excellent stock conditions. Salmon catches peaked in 1980 when over 15.5 million fish were harvested with record pink and sockeye catches occurring that year.

More fish are harvested on the south side of the Peninsula than on the north, and the species composition of the catches of these two areas is quite different. In South Peninsula waters, pink salmon account for the largest proportion of the catch with sockeyes and chums comprising the majority of the remainder of the harvest. Limited numbers of cohos are also taken. Along the north side of the Peninsula, sockeye salmon is the most important species with chums, cohos, and small numbers of kings and pinks accounting for the rest of the catch (Figure 9-1).

**Figure 9-1: Total Alaska Peninsula commercial salmon catch, and typical species composition, 1951-1983**



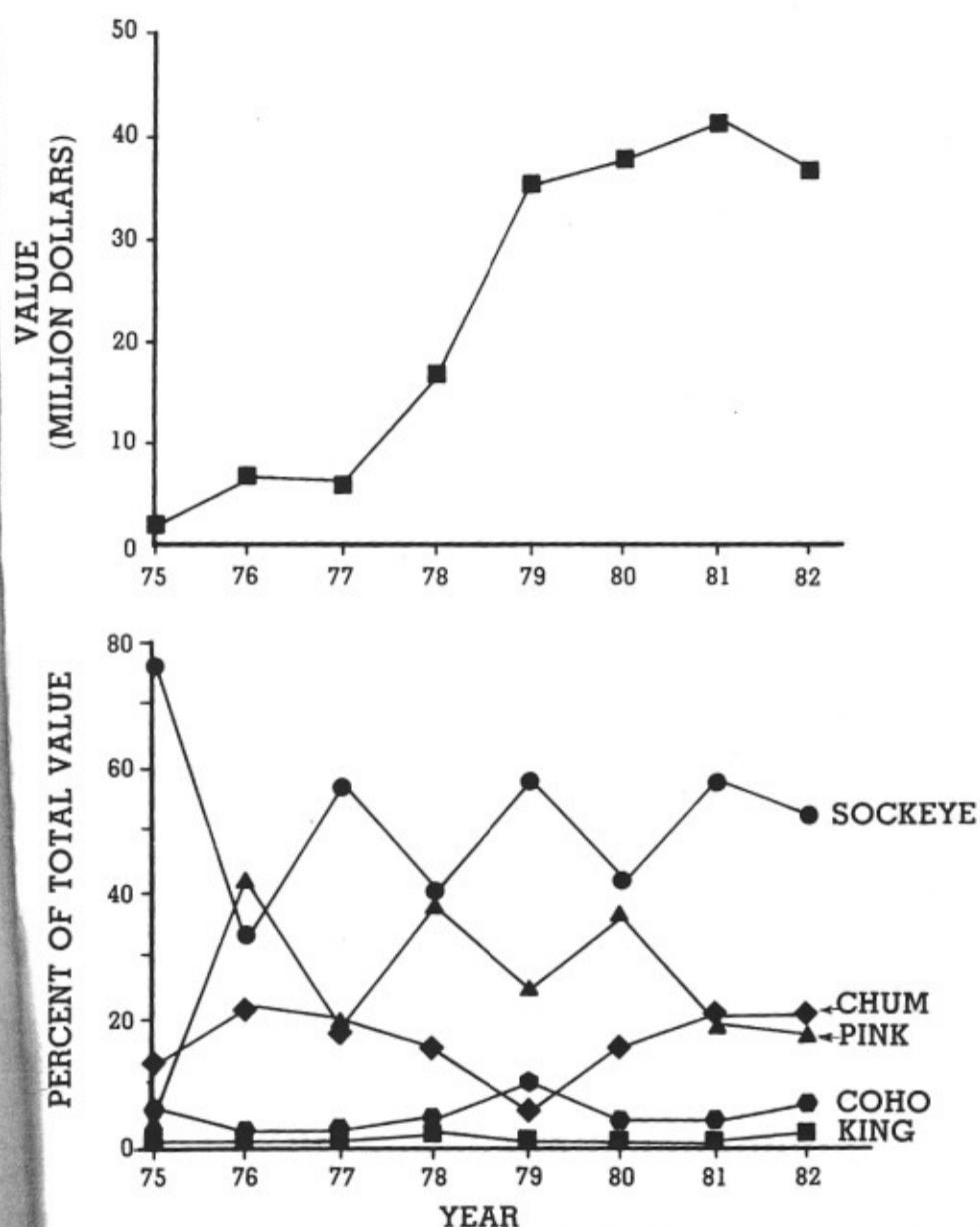
Source: ADF&G 1983

### Value

The ex-vessel value (dollars paid to the fishermen) of the Alaska Peninsula's salmon fishery increased rapidly during the late 1970's but has since leveled off (Figure 9-2). As the salmon catch has increased over the past eight years, salmon prices have also generally increased, although in 1982 and 1983 prices declined. In 1975, the total catch was worth only about \$1.7 million to fishermen; in 1982, it was worth nearly \$36.7 million. The relative contribution of each salmon species to the fishery's total value varies from year to year

off (Figure 9-2). As the salmon catch has increased over the past eight years, salmon prices have also generally increased, although in 1982 and 1983 prices declined. In 1975, the total catch was worth only about \$1.7 million to fishermen; in 1982, it was worth nearly \$36.7 million. The relative contribution of each salmon species to the fishery's total value varies from year to year (Figure 9-2), but the sockeye harvest consistently contributes the greatest proportion of the value (52 percent in 1982). Pinks and chums are of secondary importance (17 and 21 percent of the catch, respectively, in 1982), and cohos and kings provide relatively small contributions (Tobolski and Langdon 1982, ADF&G 1982).

**Figure 9-2: Value to the fisherman of Alaska Peninsula salmon harvest, 1975-1982**

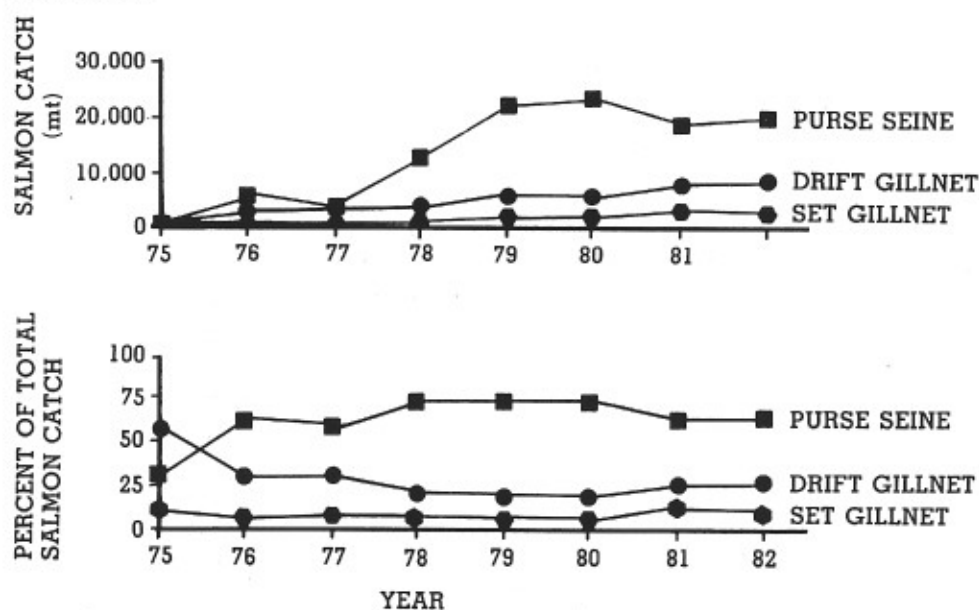


Sources: Tobolski and Langdon 1982, Shaul, ADF&G, personal communication

## Gear

Both gillnet and purse seine gear are extensively used in the Alaska Peninsula salmon fisheries. In general, drift gillnets are more frequently used in the North Peninsula fisheries and purse seines more commonly used in South Peninsula fisheries. There are two types of seine gear used in the Alaska Peninsula salmon fisheries: hand purse seines, and power deep water seines. Hand purse seining is used by many Alaska Peninsula fishermen in early August when pink salmon enter the shallow bays of the Southern Peninsula. When the large limit seiners participate, the actual seining is accomplished by two skiffs, with the large vessel acting as a tender. Both hand and power seines are used in deeper waters with power deep water seining only being used by the larger boats. Since the total harvest of salmon in the Alaska Peninsula Management Area has increased during the last decade, the actual fish tonnage landed by each gear type has also increased. However, the proportion of the catch taken by various gear types has changed dramatically since 1975 (Figure 9-3). Purse seine gear started being used extensively by South Peninsula fishermen in 1976. In 1975, seiners took only 32 percent of the harvest, in 1976 they took 63 percent, and by 1978 they took 75 percent of the catch. Since then the seine-caught proportion of the catch has stabilized. Most of the remainder (about 18 percent) of the commercial salmon harvest is taken by drift gillnetters. Set gillnetters have consistently accounted for less than 10 percent of the catch since 1975.

**Figure 9-3: Alaska Peninsula salmon harvest by gear type, 1975-1982**



Sources: Tobolski and Langdon 1982; Shaul, ADF&G, personal communication

## EFFORT

Salmon fishing on the Alaska Peninsula has been under a limited entry system since 1975. Permits are issued for set gillnet, drift gillnet, and purse seine gear for the entire Alaska Peninsula/Aleutians Area (Area M). In 1983, there were 407 permits issued for this area. While the number of permits has remained relatively stable since 1975, overall effort has increased during the

munication). The major reasons for this increased effort are: 1) boats have been upgraded and are now much more efficient, especially seine boats; and 2) through a variety of transfer and lease arrangements, each permit is now often fished all season rather than for only a portion of a season.

### Fishermen

The majority of fishermen that fish the Alaska Peninsula are residents of the region. Of the 401 permits issued for Area M in 1980, the last year for which complete data on residency are available, 261 were held by 151 Alaska Peninsula residents (Table 9-1). In Alaska Peninsula communities, it is common for individuals to hold permits for more than one gear type. Compared to other areas in rural Alaska, there have been relatively few permits transferred to fishermen outside the area, although the number of transfers has increased in recent years (CFEC 1983).

**Table 9-1: Area M salmon limited entry permits owned by Sand Point, King Cove, False Pass, and Nelson Lagoon residents, 1980**

VILLAGE	Gear Type				Number of Permit Holders	Average Number of Permits/Holder
	PS <sup>1</sup>	DG <sup>2</sup>	SG <sup>3</sup>	Total		
Sand Point	50	29	39	118	73	1.6
King Cove	36	37	12	85	45	1.9
False Pass	7	9	7	23	10	2.3
Nelson Lagoon	2	15	18	35	23	1.5
TOTAL PERMITS HELD BY ALEUTIANS EAST CRSA RESIDENTS	95	90	76	261	151	
TOTAL AREA M PERMITS	125	163	113	401		

<sup>1</sup>Purse Seine

<sup>2</sup>Drift Gillnet

<sup>3</sup>Set Gillnet

Sources: Tobolski and Langdon 1982; Commercial Fisheries Entry Commission

### Crew

The number and composition of fishing crews varies widely on Alaska Peninsula fishing boats by gear type and residency of skippers. The large limit seiners which are primarily from Sand Point utilize the largest crews with a skipper and a crew of five being most common. Many crew members are experienced seiners from out of state, usually from Washington. Other crew members are often relatives of the permit holder. Hand purse seiners have three to four man crews, with a combination of residents and non-residents filling the positions. Drift gillnet boats usually have two man crews (the skipper plus one crew member), although some of the larger, newer boats operate with three member crews. In most cases crew members are family members, although experienced, non-resident drift gillnetters are sometimes used. Set gillnetting tends to be a family operation with only a two-man crew required. It is quite common, however, for additional family members to help out with an operation.

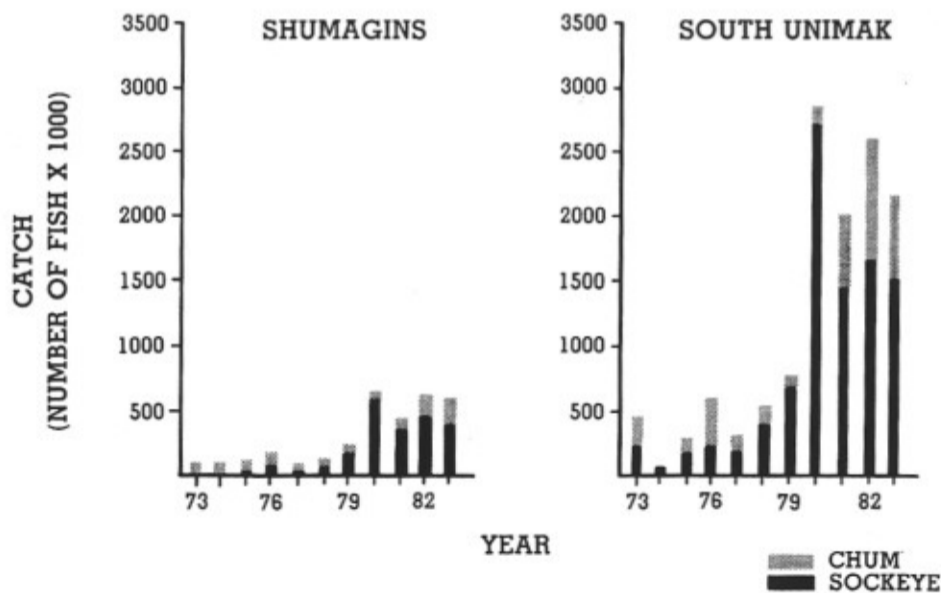
## SOUTH PENINSULA FISHERIES

The South Peninsula is divided into four fishing districts (Map H). In the Southeastern, Southcentral and Southwestern Districts pink salmon harvests predominate. In odd-numbered years there are relatively few pinks in the western part of the Southwestern District (ADF&G 1982). Large numbers of sockeyes and chums are taken along the South Peninsula in the June fishery which is concentrated in the Unimak District, and in July fisheries in the Southwestern District.

### South Unimak and Shumagin Islands June Fisheries

The South Unimak and Shumagin Island June salmon fisheries target on sockeye salmon. Since 1975, guideline harvests have been set for these fisheries as a proportion of the forecasted sockeye harvest for Bristol Bay. By regulation (5ACC 09.365), the maximum allowable percentages of the forecasted Bristol Bay harvest that both fisheries may harvest is 8.3 percent. The South Unimak fishery is allocated 6.8 percent of the forecasted Bristol Bay run and Shumagin June fishery 1.5 percent of the forecasted run. Since forecasts are only estimates, the actual proportion of the total Bristol Bay harvest taken by these two fisheries has varied from year to year but between 1975 and 1982 together averaged 6.8 percent. This is 1.5 percent less than the cumulative 8.3 percent maximum allowable harvest. Approximately 80 percent of the harvest is taken by the South Unimak fishery. Fishing effort is distributed throughout the month of June to insure that no one stock is overharvested in this mixed stock fishery. Chum salmon and small numbers of king salmon are taken incidental to the sockeye harvest in both fisheries, especially the South Unimak fishery (Figure 9-4). In some years, small, low-value pink salmon are also taken as a by-catch. Purse seine, drift gillnets, and set gillnets are used in this fishery with purse seiners and drift gillnetters taking almost all the catch in the South Unimak area, and purse seiners taking all but a very small proportion of the Shumagin catch. Fishermen from all Aleutians East CRSA villages participate in these fisheries.

Figure 9-4: South Peninsula June fisheries salmon catch, 1973-1983



Sources: ADF&G 1982; Shaul, ADF&G, personal communication

### **Unimak District**

The major activity of the Unimak District is the June fishery for sockeyes and chums described above. East and West Anchor Cove are especially important anchorage and offloading areas for the drift gillnetters, while seiners tend to fish and offload their catch in the more open waters of Unimak Bight.

### **Southwestern District**

Pink salmon is the major species harvested in this district with Volcano Bay, Belkofski Bay, the waters off Deer Island, and Ikatan Bay being the major fishing grounds. Pinks are taken primarily by local seiners with the run peaking in early August. Chums are also taken in significant numbers in Volcano Bay, Belkofski Bay, and Cold Bay.

### **South Central District**

In this relatively small district, drift gillnetting is not allowed. Pinks and chums are the only species harvested in significant numbers, with East Pavlof Bay, Canoe Bay, and Coal Bay being the major fishing grounds. Both King Cove and Sand Point fishermen regularly fish in this district.

### **Southeastern District**

The Southeastern District salmon fishery begins with sockeye and chum fishing in June. The Shumagin June fishery and the Peninsula mainland set gillnet fishery continue through July 10. Fishing for pinks and chums starts in mid-July with pinks peaking in early August. Pink salmon, mostly harvested by the Sand Point purse seine fleet, is the major species in this district. They are initially harvested in mid- to late July in the deeper waters off the Shumagin Islands, then in late July and early August in the shallower bays along the Peninsula. Some of the larger seiners continue to fish for pinks in the deeper waters off the capes throughout the season. There are scattered but abundant harvests of other salmon species including chums, sockeyes, and cohos throughout the district with the Popof Head area being most important in 1982. Set gillnet sites are scattered in the District's bays, with concentrations in Balboa and Stepovak Bays.

## **NORTH PENINSULA FISHERIES**

The North Peninsula is divided into two districts (Map H). The Northwestern District harvest totaled approximately 134,000 salmon in 1982, primarily chums (70 percent) and sockeyes (25 percent). The major local chum producing areas are Bechevin Bay, Izembek Lagoon and Moffet Bay. The total catches are greater in the Northern District with 1.9 million salmon harvested in 1982. Sockeyes accounted for 73 percent of the catch with significant numbers of chums (12 percent) and cohos (12 percent) also taken. The Bear River Section is the major sockeye (over 900,000 fish in 1982) and chum (121,389 fish in 1982) producer; Nelson Lagoon is the major coho area (170,692 fish in 1982) as well as also being an important harvest area for sockeye, king, and chum salmon.

### Urilia Bay Section

The Urilia Bay/Swanson Lagoon/Bechevin Bay fishery concentrates on sockeye salmon. Chum salmon are also taken in Bechevin Bay and Swanson Lagoon, and pink salmon are occasionally taken in Bechevin Bay. False Pass fishermen using hand purse seines dominate this fishery which occurs in two peaks; the first for sockeyes in late June and early July, and the second for chums in early through mid-August.

### Izembek and Moffet Lagoons

The Izembek-Moffet Lagoon fishery is an extremely productive chum fishery. Sockeyes are also important in this area. Most of the fish are taken by hand purse seiners from King Cove and False Pass from mid-July through early August. The Izembek fishery is considered to be difficult and frustrating because of shallow, turbid waters.

### Nelson Lagoon

The Nelson Lagoon fishery is diverse with all species except pinks being harvested in significant quantities. The king and sockeye fishery begins in early June. King salmon fishing continues through July and sockeye fishing until September 1. Chum salmon fishing is concentrated in mid-July through early August and coho fishing begins in August and continues through mid-September. This fishery is almost exclusively used by Nelson Lagoon residents and only drift and set gillnets are legal gear.

### Herendeen Bay and Port Moller

Herendeen Bay supports a major chum salmon fishery and Port Moller supports a sockeye fishery. The chum harvest occurs throughout July and peaks in mid-July. The sockeye runs are strong in Port Moller and the Bear River drainage throughout July and August. The relatively small Herendeen Bay sockeye runs peak in mid-July. Seines, drift gillnets and purse seines are all used in this fishery. About half the participating fishermen come from other parts of Alaska and Washington and half come from Alaska Peninsula communities. Most local seining and gillnetting is conducted in Herendeen Bay during several weeks in July after the Unimak June fishery. Most gillnetters and occasional seiners fish this area when the sockeye runs at Bear River and Nelson Lagoon are slack (Shaul, ADF&G, personal communication).

### Bear and Sandy Rivers

This highly productive sockeye area is almost exclusively fished by gillnetters, mostly drift gillnetters. Fishing activity occurs in the surf zone along the coast. In 1982, over one million sockeyes were harvested in this area with the catch peaking in late June and early July, but remaining strong until mid-August.

## PROCESSING

Much of the Alaska Peninsula salmon catch is processed onshore within the region at either canneries or freezer facilities located at King Cove, Sand Point, Port Moller, and Cold Bay, or onboard floating processors that spend varying amounts of time within the District (Map H). Some fish is tendered out of the District to canneries in Dutch Harbor, Chignik, and, less frequently, other locations for processing. Both canned and frozen salmon are produced within the Aleutians East CRSA, with the proportion of the pack going to each

Peninsula  
ed in the  
in South  
e Alaska  
er seines  
n in early  
eninsula.  
mplished  
nd power  
ly being  
e Alaska  
e actual  
the pro  
natically  
sively by  
rcent of  
rcent of  
abilized  
arvest is  
for less

ype.

SEINE

GILLNE  
LNET

EINE

LLNE  
NET

entri  
urse  
1983  
has

product form varying from year to year largely depending on market conditions. Almost all pink salmon is canned, while larger proportions of the sockeye, chum, coho, and king salmon harvests are frozen. Only very limited quantities of salmon are transported by air to fresh fish markets. While salmon processing contributes significantly to the region's economy, relatively few local residents are employed in this activity.

Salmon processing within the Aleutians East CRSA has undergone a radical transformation within the last five years. Prior to that time, the region's canneries controlled all salmon processing activities. Most fishermen fished exclusively for a cannery, and in return were provided with a wide variety of services. In recent years, numerous fish buyers with floating processing vessels (usually called cash buyers) have started buying fish in the area, dramatically increasing the competitive nature of the within region processing sector.

In both 1982 and 1983, twenty-two floating processors operated in the Alaska Peninsula District. Since most of these processors are en route to Bristol Bay, they only operate in the Aleutians East CRSA for the month of June buying sockeyes and chums in the Unimak District. The presence of these floaters has made competition for fish intense during this period and resulted in higher prices being paid to fishermen. A few floaters return to Alaska Peninsula waters in late July after the Bristol Bay run has tapered off. For the last two years, three floaters have remained in Port Moller for most of the season.

### **SALMON ENHANCEMENT ACTIVITIES**

There is one salmon hatchery in the Aleutians East CRSA. The Russell Creek Hatchery, which is located near Cold Bay, was designed to incubate 50 million chum salmon eggs, rear 39 million fingerlings, and return 750,000 adult salmon for harvest annually. Design errors have thus far limited Russell Creek hatchery production to a brood-stock maintenance program of 14 million eggs. The future of the Russell Creek Hatchery is currently being decided. Several re-designs of the hatchery have been completed. The Fisheries Rehabilitation, Enhancement, and Development Division of the Alaska Department of Fish and Game point out the following advantages of upgrading the facility to at least original design capacity (Moberly 1983): 1) an existing basic plant will be used; 2) 750,000 chum salmon will be produced annually to augment existing Alaska Peninsula fisheries; 3) the hatchery is located in an ideal management area with no mixed-stock fisheries; 4) existing processors are available to handle the fish; 5) the local fishermen support the hatchery; and 6) the hatchery has a favorable return on investment.

---

## **CHAPTER 10**

### **Herring Fishery**

---

The commercial herring fishery in Aleutians East CRSA waters has not yet fully developed, although fishing occurs both on the north and south sides of the Alaska Peninsula. Important fishing grounds are shown on Map H. To date, local participation in these fisheries has been limited, primarily because of the timing of the spring roe herring fishery and the newness of the food/bait fishery.

#### **SOUTH PENINSULA**

Fishing for herring in South Peninsula waters began during the summer of 1979 with a 10 ton harvest that targeted females with mature roe (roe herring). Harvests increased substantially during the next two years and in 1981, 722 tons of roe herring were taken. In 1982, the roe fishery was much smaller (176 tons), and a winter herring fishery for food and bait harvested 565 tons of herring (Table 10-1). The major South Peninsula roe herring fishing ground is Canoe Bay with smaller quantities being harvested in many of the small bays from Stepovak Bay to Cold Bay; the food fishery occurred exclusively in Stepovak Bay (ADF&G 1982; Malloy, ADF&G, personal communication). Fishing for roe herring in South Peninsula waters was prohibited for the 1983-season, and extensive efforts to locate food and bait herring during the winter and fall were unsuccessful. Hence there were no commercial herring harvests from South Peninsula waters during 1983. (Malloy, ADF&G, personal communication).

The value of the South Peninsula herring fishery grew from \$326,000 in 1980 to \$747,000 in 1981. In 1982, the ex-vessel value of the fishery dropped, reflecting a reduced harvest resulting from decreased commercial effort for roe herring and the start of a food/bait herring fishery. In 1982 roe herring (10% roe content) were valued at \$550/ton, while bait herring brought \$240/ton, and food herring only \$160/ton. Hence the 565 ton food/bait harvest brought fishermen \$104,000, while the 176 ton sac roe harvest was worth \$97,000 to fishermen (ADF&G 1982). Except for the 10 ton harvest in 1979, all South Peninsula herring landings have been made by seiners who live outside the Aleutians East CRSA. Several local boats did participate in the 1982 food/bait fishery as tenders. In 1982 the entire South Peninsula herring harvest was processed (frozen) at the Aleutian Cold Storage facility in Sand Point. Local interest in the herring fishery is largely in the food/bait fishery which occurs during the fall and winter (Malloy, ADF&G, personal communication).

The future growth of the South Peninsula herring fishery is difficult to predict since neither stock size and stability nor overwintering locations are known. Future allocations between the roe herring and food/bait herring fisheries are also uncertain.

#### **NORTH PENINSULA**

The North Peninsula herring fishery has been exclusively for roe herring and is currently limited to the Port Moller/Herendeen Bay vicinity. Landings were first made in 1982 when 514 tons were harvested. Catches increased in 1983 with landings of 638 tons (Table 10-1). Ex-vessel value of the Port Moller herring

harvest was \$414,000 in 1983.

Effort in this fishery, which occurs during a period from mid-May to early June, is primarily by seiners that come down from the Togiak Fishing District during closed fishing periods in that area. In 1983, three local gillnetters from Nelson Lagoon participated in the fishery (Malloy, ADF&G, personal communication).

Most of the Port Moller catch has been sold to floating processors located in Togiak which send tenders to Port Moller to accompany the seiners. In 1983, however, the Peter Pan Seafoods facility at Port Moller custom-processed some of the herring harvested both from this area and the Togiak District.

**Table 10-1: Alaska Peninsula herring harvests, effort, and ex-vessel value 1979-1983**

Year	HARVEST				
	Food/Bait (tons)	Sac Roe (tons)	Total (tons)	Vessels (no.)	Ex-vessel Value (\$)
— SOUTH PENINSULA —					
1979	0	10	10	1	—
1980	0	453	453	6	\$326,000
1981	0	787	787	40	\$747,000
1982	565	176	741	7	\$167,500
1983	0	closed	0	6	0
— NORTH PENINSULA —					
1982	0	514	514	3	\$252,000
1983	0	638	638	19	\$414,369

Sources: ADF&G 1982; Malloy, ADF&G, personal communication

## **CHAPTER 11**

### **Halibut Fishery**

The halibut fishery has been important in the Gulf of Alaska since World War I, when the fishery expanded north and west from continental U.S. and British Columbia waters. Halibut fishing in the Bering Sea began in 1928, although harvests were sporadic until 1952. Halibut were traditionally harvested by both Canadian and U.S. fishermen; however, additional foreign fishing for halibut by Japan and the Soviet Union was allowed in the Bering Sea from 1962 to 1976. Canadian fishermen have been gradually phased out of fishing in U.S. waters, and in 1981 halibut fishing in U.S. waters was restricted to U.S. fishermen only. Significant quantities of halibut, however, continue to be taken by foreign fisheries as an incidental catch.

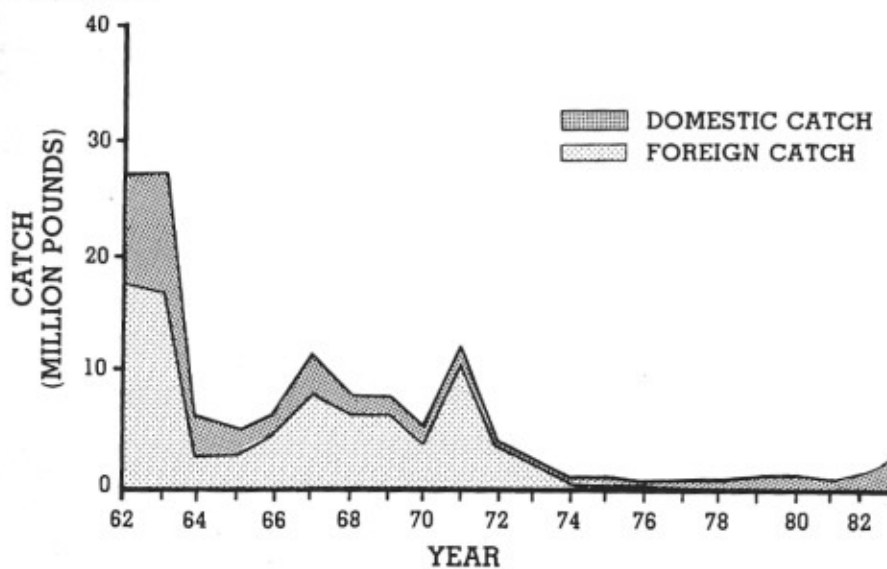
## CATCH

The Gulf of Alaska halibut fishery is larger than the Bering Sea fishery. In both areas, harvests peaked in the early and mid-1960s. Stocks and catches declined dramatically in the 1970's. Beginning in 1981 catches have again started to increase and stocks are showing some signs of recovery (Figures 11-1 and 11-2).

Halibut fishing in the waters adjacent to the Aleutians East CRSA is restricted to the Gulf of Alaska. The entire Bristol Bay area, including the waters to the north of the Aleutians East CRSA, is designated a halibut nursery area and is closed to all halibut fishing. Gulf of Alaska halibut fishing grounds to the south of the Aleutians East CRSA, illustrated in Map I, are concentrated around the Shumagin Islands, off Sanak Island, and on Davidson Bank. Most of the catch comes from the Shumagin Island area. While these areas are consistent producers, fishing grounds to the east, especially near Kodiak Island, produce much larger quantities of halibut. As illustrated in Figure 11-2, the relative quantity of halibut caught in the waters south of the Aleutians East CRSA compared to the entire northern Gulf of Alaska (from Cape Spencer west) is small. This catch is, however, significant to local fishermen and processors.

Halibut are a relatively high value species whose price can vary widely from year to year. Based on average halibut ex-vessel prices, the value of the halibut landed from waters south of the Aleutians East CRSA has ranged from about \$69,000 to \$500,000 during the last five years. During this same period, the average ex-vessel value of the entire northern Gulf of Alaska halibut catch has ranged from \$12 to \$25 million.

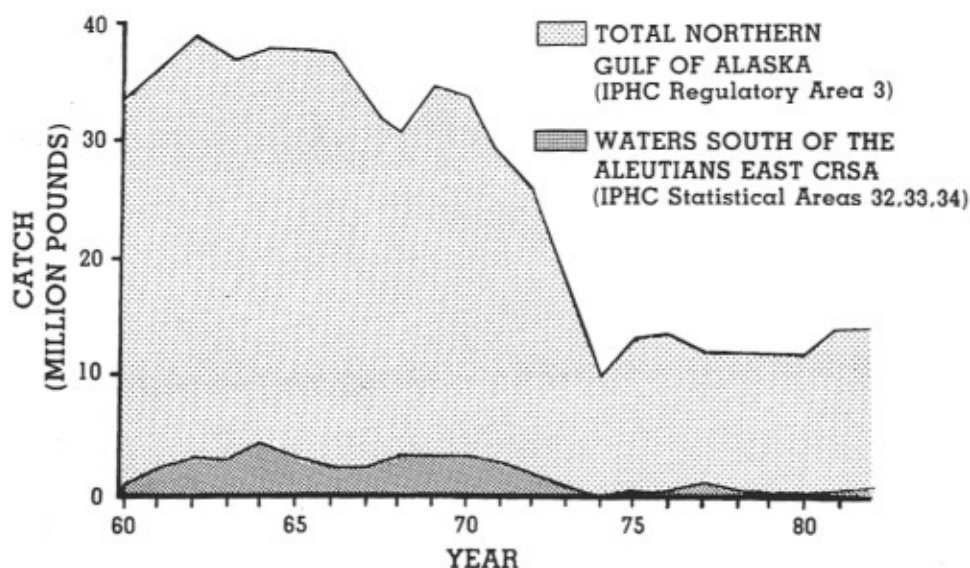
**Figure 11-1: Commercial halibut catch from the Bering Sea, 1962-1983**



Sources: BBCMP 1983; Best, IPHC, personal communication

**Figure 11-2: Commercial halibut catch from the northern Gulf of Alaska, 1960-1983**

## Gulf of Alaska, 1960-1983



Source: International Pacific Halibut Commission Annual Reports 1979-1982. Best, IPHC, personal communication

## EFFORT

Most of the halibut harvested off the Aleutians East CRSA are taken by large halibut boats from Washington and Alaskan ports outside the Aleutians East CRSA. Local participation in the fishery has been limited to a maximum of 35 small (less than 40 feet in length) boats from King Cove and Sand Point. While there is considerable local interest in expanding participation in the halibut fishery, halibut openings in recent years have occurred during the summer and conflicted with the salmon season.

Overall effort in the halibut fishery has increased markedly during the last decade. Increased effort coupled with low stock levels has resulted in extremely short fishing seasons. In 1980, the fishing season in Area 3B, which includes the waters to the south of the Aleutians East CRSA, lasted 20 days; in 1981, 16 days; in 1982, 11 days; and in 1983 only 10 days. Currently there is no limited entry system for halibut, but the North Pacific Fisheries Management Council (NPFMC) has been exploring both moratoria and limited entry systems.

## PROCESSING

While King Cove and Sand Point are not major halibut landing ports, both Aleutian Cold Storage in Sand Point and Peter Pan in King Cove freeze halibut. Both companies are planning to increase their halibut production.

## **MANAGEMENT**

The Northern Gulf of Alaska and Bering Sea halibut fisheries are managed by the International Pacific Halibut Commission (IPHC) under a bilateral treaty between the U.S. and Canada. The IPHC sets halibut catch levels and seasons, restricts fishermen to using only hook and lines as gear, and makes it illegal to possess a halibut less than 81.3 cm (32 in) in length. In addition, the IPHC has closed certain areas to halibut fishing for stock protection.

The North Pacific Fisheries Management Council also exerts significant influence over halibut fisheries in the Fisheries Conservation Zone. They have made halibut a prohibited species to foreign fishermen and have instituted time-area closures to protect halibut stocks and reduce gear conflicts.

---

# **CHAPTER 12**

## **Groundfish Fisheries**

---

### **INTRODUCTION**

The Aleutians East CRSA is located in the middle of one of the world's richest groundfish fishing areas. To the north is the Bering Sea with an estimated maximum sustainable yield (MSY) between 1.7 and 2.3 million metric tons of groundfish. South of the Peninsula is the Gulf of Alaska with an estimated MSY of 0.5 to 0.8 million metric tons of groundfish (Tables 12-1 and 12-2). The groundfish fisheries in both areas are dominated by foreign fishermen, although domestic participation in the harvesting sector has increased significantly during the last several years. Currently, groundfish fisheries have little economic impact on the Aleutians East CRSA.

The Bering Sea commercial groundfish fishery is significantly larger than that of the Gulf of Alaska. However, more fishing occurs in Gulf of Alaska waters immediately adjacent to the Aleutians East CRSA than in adjacent Bering Sea waters because of regulatory restrictions which restrict foreign fishing north of Unimak Island and the Alaska Peninsula (Map I).

In both the Bering Sea and Gulf of Alaska, pollock comprise by far the largest proportion of the catch, with Pacific cod also being an important species. Small flounders are the second most important group; however, yellowfin sole, which comprise a significant portion of the Bering Sea catch, are not commercially caught in Gulf of Alaska waters. Sablefish and rockfish, relatively minor species in both fishing areas, are of greater commercial importance in the Gulf than in the Bering Sea. In both the Gulf of Alaska and the Bering Sea, commercial fishing for groundfish is concentrated along the outer continental shelf and upper slope, although recent domestic efforts have occurred in shallower waters closer to shore (Map I).

Foreign groundfish fishing vessels are either large (gross tonnage of 1,500 tons or greater) or medium (gross tonnage less than 1,500 tons) trawlers, longline vessels, transport vessels, and oil tankers. By far the greatest proportion of the groundfish catch is taken by trawlers (Morris et al. 1983). Domestic groundfish catcher vessels tend to be greater than 90 feet in length (crabber/dragger class), although some smaller boats have participated in groundfish ventures. In addition, several relatively large (greater than 200 feet) domestic catcher-processor vessels have recently entered the groundfish fishery.

**Table 12-1: Maximum sustainable yield, 1983 optimum yield, domestic annual harvest, and resource condition of Gulf of Alaska groundfish stocks**

Species	MSY <sup>1</sup> (x 1,000 mt)	OY <sup>2</sup> (x 1,000 mt)	% of OY apportioned to Western Gulf	1983 Western Area DAH <sup>3</sup> (x 1,000 mt)	Resource <sup>4</sup> Condition
Pollock	169-334	217	26%	15.8	+
Pacific Cod	88-177	60	28%	1.9	+
Flounders	67	33.5	31%	.7	+
Pacific Ocean Perch	125-150	11.5	24%	.3	-
Other Rockfish	7.6-10	7.6	Gulf-wide OY	.9*	+
Sablefish	22-25	8.2-9.4	-	.3	-
<i>Sebastes</i> sp.	3.8	3.8	Gulf-wide OY	.006	+
Atka Mackerel	33	28.7	16%	.3	+
Squid	5	5	Gulf-wide OY	.15*	+
Other Species <sup>5</sup>	-	18.8	Gulf-wide OY	7.7*	+
<b>TOTAL</b>	<b>562-825</b>	<b>394</b>			

<sup>1</sup>Maximum Sustainable Yield (MSY) is an average, over a reasonable length of time, of the largest catch which can be taken continuously from a stock under current environmental conditions.

<sup>2</sup>Optimum Yield (OY) is that which provides the greatest overall benefit to the nation with particular references to food production and recreational fisheries. OY is based upon MSY for a given species, modified by relevant economic, social, and/or biological factors.

<sup>3</sup>1983 Western Area Domestic Annual Harvest (DAH) is the estimated total harvest of groundfish by U.S. fishermen in the Western Regulatory Area. Almost all of this harvest is allocated to joint-venture operations. \* indicates a Gulf-wide DAH.

<sup>4</sup>+, current conditions allow stock(s) to be fished at or near MSY.

-, current conditions do not allow stock(s) to be fished at or near MSY (from Alton 1981).

<sup>5</sup>Includes rattails, shark, skates, sculpins, eulachon, smelts, octopus, and capelin.

Source: NPFMC 1983a

**Table 12-2: Maximum sustainable yield, 1983 optimum yield, domestic annual harvest, and resource condition of Bering Sea groundfish stocks <sup>1</sup>**

Species	MSY ( × 1,000 mt)	OY ( × 1,000 mt)	DAH ( × 1,000 mt)	Resource Condition
Pollock	1,100-1,600	1,000	74.3	+
Yellowfin sole	169-260	117	31.2	+
Turbots	100	90	1.1	+
Other Flatfish	44.3-76.8	61	11.2	+
Pacific Cod	55	120	43.3	+
Pacific Ocean Perch	32	3.25	1.4	+
Other Rockfish	—	7.7	1.6	+
Sablefish	11.6	3.5	0.7	—
Atka Mackerel	33	24.8	14.5	+
Squid	10	10	0.05	+
Other Species	89.4	77.3	7.8	+
<b>TOTAL</b>	<b>1,721.2-2,344.7</b>	<b>1,516.6</b>	<b>188.6</b>	

<sup>1</sup>See Table 12-1 for definitions of MSY, OY, DAH, and Resource Condition.

Source: NPFMC 1983b.

## History

The first commercial venture for groundfish in the Aleutians East CRSA area began in 1865 when American fishermen harvested cod in the vicinity of the Shumagin Islands. The pioneering efforts were carried out by large schooner vessels sailing from San Francisco and Puget Sound ports as well as by small, one-man dories operating from shore stations located at Pirate Cove on Popof Island, Little Koniuji Island, Unga Island, and on Sanak, Unimak, and Unalaska Islands. While a few cod schooners continued to operate until the early 1950s, cod catches were largest between 1905 and 1920. Peak production occurred during World War I when annual catches averaged about 44 million pounds (Natural Resources Consultants 1981). The main product from the early cod fishery was dry-salted cod.

Subsequent participation by U.S. fishermen in groundfish fisheries in both the Gulf of Alaska and the Bering Sea remained minimal until recent years. In the interim, foreign fishermen dominated in both areas. Foreign fishing in waters of the Aleutians East CRSA began with exploratory and small scale operations in the eastern Bering Sea by Japan during the 1930's. Significant foreign groundfish harvests did not begin until the late 1950's when both Japanese and Soviet vessels started fishing for yellowfin sole and other flounders in the Bering Sea. Catches for these species peaked at just over 10.6 million mt in 1961, then declined as the stocks were depleted. In the mid-1960's fishing effort shifted from flounders to pollock. The Republic of Korea (ROK) joined Japan and the Soviet Union as harvesters although their catches remained relatively small. Harvests of both pollock and total groundfish peaked in the early 1970's at over 2 million mt as stocks were again over-exploited. By the late 1970's, harvests had stabilized at about 1 million metric tons (mt) per year (NPFMC 1979a, 1979b). In the Gulf of Alaska, foreign fishing began in the mid-1960's with Japanese and Russian trawlers and longliners targeting on Pacific Ocean perch and sablefish. As these stocks declined in the 1970's total catch declined and effort shifted to pollock and Atka

mackerel. Total Gulf of Alaska groundfish catches have been between 150,000 and 230,000 mt annually for the last five years. Japan and, to a lesser extent, the Republic of Korea, continue to dominate foreign harvests of groundfish in both the Bering Sea and Gulf of Alaska. Soviet fishing in the U.S. Fisheries Conservation Zone has not been allowed since 1981. In recent years, relatively small allocations of groundfish have been given to Taiwan, Poland, and West Germany.

## **Management**

The groundfish fisheries of the Gulf of Alaska and the Bering Sea are managed by the North Pacific Fisheries Management Council (NPFMC) in the Fishery Conservation Zone (FCZ) which extends from 3 to 200 miles offshore and by the Alaska Department of Fish and Game within 3 miles of shore. Because almost all groundfish fishing in both the Western Gulf of Alaska and the Southeastern Bering Sea occurs within the FCZ, the largest management responsibility lies with the NPFMC. The NPFMC has adopted groundfish management plans for both areas that include catch limits, area-time closures, and gear restrictions (NPFMC 1979a, 1979b). The NPFMC also allocates the catch quota for each species between domestic and foreign fishermen (Tables 12-1 and 12-2). The allocation priorities of the NPFMC move sequentially from domestic operations, joint ventures, and lastly to foreign operations.

The marine waters adjacent to the Aleutians East CRSA are part of the NPFMC's Western Regulatory District of the Gulf of Alaska (identical to International North Pacific Fisheries Commission Shumagin area) which extends from 160° to 170° W longitude, and Area I of the Bering Sea which encompasses all waters east of 170° W longitude.

## **Prohibited Species**

Groundfish fisheries, especially trawl fisheries, harvest species other than those that are sought. In certain cases, the incidental catch can be of tremendous significance. In recognition of this fact, the NPFMC has designated certain fish species as "prohibited species" which means they should be avoided by groundfish fishermen and cannot be retained if caught. If a prohibited species quota is exceeded, fishing for the targeted species must also cease. Currently, the prohibited species concept applies only to foreign fishing operations and not to the developing domestic groundfish fishery (NPFMC 1983a, b).

Prohibited species and catch quotas vary by area. In general, species which are harvested by domestic fishermen in other commercial fisheries are prohibited species. This group includes salmon, halibut, crab, herring, scallops, and any species for which the NPFMC has set an optimum yield of zero. Specific gear restrictions and time-area closures have been instituted by the NPFMC, to reduce the incidental catch of prohibited species.

## GULF OF ALASKA FISHERIES

The Gulf of Alaska supports major commercial groundfish fisheries with about 225,000 mt of groundfish annually harvested during the last several years (Table 12-3). Through 1980, foreign fleets harvested more than 99 percent of the Gulf of Alaska groundfish catch. In 1981, a joint venture for pollock began and significant domestic catches were made. Joint venture catches, primarily of pollock, have since increased dramatically and in 1982 accounted for 33 percent of the total Gulf of Alaska catch; however, almost none of the joint venture catch was taken from the Shumagin District. Domestic landings to domestic processors remain limited with sablefish, Pacific cod, flounders, and rockfish comprising the bulk of the catch which amounted to only 3,670 mt in 1981 (Smith 1982); nearly all of this catch is taken near Petersburg and around Kodiak Island.

Each year the NPFMC sets quotas for groundfish catches in the Gulf of Alaska and the Western Regulatory Area. The Western Area allocations (Table 12-1) and recent catches in that area (Table 12-4) provide a good perspective of the relative importance of fishing grounds south of the Aleutians East CRSA to the entire Gulf of Alaska. While the geographic distribution of the catch changes from year to year, significant proportions of the total Gulf of Alaska harvest of pollock, Pacific cod, squid, and, recently, Atka mackerel, Pacific Ocean perch, and other rockfish come from the Western Gulf of Alaska. Almost all the Western Gulf of Alaska catch continues to be taken by foreign fishermen.

**Table 12-3: Total groundfish harvest taken by foreign and domestic joint-venture fishermen in the Gulf of Alaska, 1980-1982**

Species	HARVEST (metric tons)					
	1980		1981		1982	
	Foreign	Joint Venture	Foreign	Joint Venture	Foreign	Joint Venture
Pollock	124,610	1,135	130,323	16,836	92,313	74,284
Flounders	16,062	208	14,442	18	8,954	18
Pacific Cod	35,506	465	34,968	58	26,690	194
Atka Mackerel	13,679	3	18,727	0	6,769	0
Pacific Ocean Perch	12,386	20	12,177	1	7,894	3
Other Rockfish	4,194	8	5,682	0	2,485	0
Sablefish	6,499	20	7,976	0	5,598	1
Other Finfish <sup>1</sup>	8,729	49	7,112	43	2,051	108
Squid	851	0	1,135	0	277	16
<b>Total</b>	<b>222,516</b>	<b>1,908</b>	<b>231,407</b>	<b>16,955</b>	<b>153,029</b>	<b>74,822</b>
<b>GRAND TOTAL</b>	<b>224,424</b>		<b>248,362</b>		<b>227,851</b>	

<sup>1</sup>Other finfish include sculpins, sharks, smelt, eulachon, skates, rattails, capelin, and octopus.

Source: National Marine Fisheries Service best blend estimates.

**Table 12-4: Foreign commercial groundfish catch in the Western Regulatory (Shumagin) Area, 1980-1982**

Species	HARVEST					
	1980		1981		1982	
	Western Area Catch	% Gulf of Alaska Catch	Western Area Catch	% Gulf of Alaska Catch	Western Area Catch	% Gulf of Alaska Catch
Pollock	46,645	41%	47,559	36%	40,228	42%
Atka Mackerel	1,718	13%	4,316	23%	3,162	47%
Pacific Cod	8,619	25%	11,313	32%	7,031	26%
Flounders	3,022	20%	3,224	26%	1,412	16%
Pacific Ocean Perch	840	7%	1,233	9%	1,746	22%
Other Rockfish	287	7%	2,185	38%	582	23%
Sablefish	1,450	24%	1,566	20%	1,489	26%
Other Finfish	2,497	29%	3,511	49%	782	38%
Squid	112	19%	542	48%	120	43%
<b>Total</b>	<b>65,190</b>	<b>31%</b>	<b>75,449</b>	<b>32%</b>	<b>56,552</b>	<b>36%</b>

Source: National Marine Fisheries Service best blend estimates.

## Foreign Fishing

The large foreign trawlers, primarily from Japan and the Republic of Korea, target on walleye pollock, Pacific cod, Atka mackerel, large flounders, and rockfish in the Gulf of Alaska (Smith 1982). They operate in relatively deep waters along the outer continental shelf and slope. Foreign longliners also operate in deep waters along the shelf edge and slope, mostly seeking sablefish (black cod) and Pacific cod. All foreign vessels are prohibited from operating within 12 miles of shore. In addition, the Davidson Bank area is closed to foreign fishing in order to encourage domestic fisheries development (NPFMC 1983a). Foreign fishing in the Gulf of Alaska occurs year-round.

## Domestic Fishing

Domestic groundfish operations in the Gulf of Alaska are centered around Kodiak with little activity in the waters south of the Aleutians East CRSA. Domestic landings from the Shumagin INPFC area have risen from 1.4 mt in 1975 to 335.7 mt in 1982 with Pacific cod comprising most of the catch (Table 12-5). The 1982 harvest was worth only \$97,000 to the 11 vessels that made landings (ADF&G 1982). Most vessels participating in the groundfish fishery were trawlers (greater than 100 feet in length) from outside the Aleutians East CRSA. In 1981 and 1982 almost all vessels targeted on Pacific cod for a salt cod operation run by Jangaard Alaskan Fisheries, Inc.; the processing facility was located onshore at Squaw Harbor. This operation is no longer in existence due to financial difficulties. In addition to the salt cod operation, several joint ventures have operated in the Gulf of Alaska near the Aleutians East CRSA. In 1982, five vessels made deliveries to the Golden Alaska, a domestic floating processor in the waters south of the Aleutians East CRSA.

**Table 12-5: Domestic landings of groundfish from the Western Regulatory (Shumagin) Area, 1975-1982**

Species	DOMESTIC LANDINGS (metric tons)							
	1975	1976	1977	1978	1979	1980	1981	1982
Pollock	0	0	0	0	0	0'	1.5'	61.4
Sablefish	0	0	0.3	0	0	1.4	0	0
Pacific Cod	1.3	13.3	54.1	64.1	0	70.5	664.7	292.2
Flounder	0	0	0	5.9	0	0	0	0
Unspecified	0.1	0	0	12.8	0	0	0	0
<b>TOTAL</b>	<b>1.4</b>	<b>13.3</b>	<b>54.4</b>	<b>82.8</b>	<b>0</b>	<b>71.9</b>	<b>666.2</b>	<b>353.6</b>
Vessels	*	*	*	8	0	*	12	11
Landings	*	*	*	12	0	*	23	23
Value (x \$1,000)	1	7	30	44	0	*	104	97

'catch figures for 1980 and 1981 were combined for confidentiality.

\* Data not available.

Source: ADF&G 1982, ADF&G Commercial Catch Reporting System.

## Stock Conditions

With the exception of sablefish and Pacific Ocean perch stocks, major fish stocks within the Gulf of Alaska appear to be in excellent condition (Table 12-1). Pollock stocks are increasing in abundance, especially in the Western and Central Regulatory areas. Pacific cod stocks are increasing throughout the Gulf despite increasing catches. Shumagin area cod stocks have increased relative to other Gulf of Alaska stocks; however, their abundance is expected to decline in the next several years. Flounder stocks have only been lightly exploited and are in excellent condition, as are Atka mackerel, squid, and other rockfish stocks. Pacific Ocean perch stocks which were heavily exploited in the early 1970s are estimated to be no higher than 20 percent of their original abundance despite recent conservation measures. Sablefish stocks remain depressed throughout the Gulf of Alaska with no short-term increases in stocks expected (Balsinger 1982).

## BERING SEA FISHERIES

The Bering Sea commercial groundfish fishery is one of the world's largest. Current total Optimum Yield (OY) is 1.5 million metric tons (Table 12-2). Harvests during the last five years have been over 1 million mt. Pollock dominate the Bering Sea groundfish catch with yellowfin sole, turbot, Pacific cod, and flounder also being important (Table 12-6).

Participants in the fishery include large foreign trawl and longline fleets, large domestic trawler-processors, and joint venture operations. While foreign fishermen continue to dominate the Bering Sea groundfish fisheries, domestic fishermen have made impressive gains in utilizing the resource during the last several years. In 1976 there were no domestic groundfish landings from the Bering Sea; in 1982 over 109,000 mt of groundfish (8 percent of the total Bering Sea harvest) were harvested by joint ventures and 13,000 mt (0.1 percent of the total catch) were harvested in fully domestic operations (Tables 12-6 and 12-7). The NPFMC sets quotas for groundfish catches in

the Bering Sea and Aleutian Islands area and allocate the harvest to various user groups (i.e., foreign, joint-venture, and domestic) on an annual basis. These quotas and allocations, by species, are presented in Table 12-2. The Domestic Annual Harvest (DAH) for 1983 represents 12 percent of the total Bering Sea/Aleutian Island area OY. More than 76 percent of this allocation has been designated to joint ventures.

**Table 12-6: Total groundfish harvest taken by foreign and domestic joint-venture fishermen in the Bering Sea, 1980-1982**

Species	HARVEST (metric tons)					
	1980		1981		1982	
	Foreign	Joint Venture	Foreign	Joint Venture	Foreign	Joint Venture
Pollock	1,006,129	10,652	986,943	42,082	959,336	54,604
Yellowfin sole	77,768	9,623	81,255	16,045	75,973	17,414
Other Flounders	33,526	2,720	34,406	5,987	23,528	9,130
Turbot	55,003	75	57,486	0	55,794	87
Pacific Cod	37,319	8,456	39,112	9,159	28,173	28
Pacific Ocean Perch	4,917	52	4,852	1	2,358	28
Other Rockfish	3,550	11	2,492	7	2,494	1
Atka Mackerel	20,224	264	18,056	1,632	7,398	12,475
Sablefish	2,438	38	2,954	180	3,838	124
Other Finfish <sup>1</sup>	46,982	678	39,390	3,434	22,260	1,106
Squid	6,374	0	5,937	4	5,033	516
<b>Total</b>	<b>1,294,230</b>	<b>32,569</b>	<b>1,272,883</b>	<b>78,531</b>	<b>1,186,185</b>	<b>109,076</b>
<b>GRAND TOTAL</b>	<b>1,326,799</b>		<b>1,351,414</b>		<b>1,295,261</b>	

<sup>1</sup>Other Finfish include sulpins, sharks, smelt, eulachon, skates, rattails, capelin, and octopus.

Source: National Marine Fisheries, Service best blend statistics.

**Table 12-7: Domestic landings of groundfish from the Southeastern Bering Sea, 1977-1982**

Species	DOMESTIC LANDINGS (metric tons)					
	1977	1978	1979	1980	1981	1982
Unspecified	0	4.7	25	30.1	0	*
Pollock	0	23.2	7.6	60.4	0	67.3
Sablefish	1.6	0	0	0	0	115.5
Pacific Cod	15.1	30.7	780.1	2,432.6	3,863.8	13,124.9
Flounder	2.3	0	0	88.2	0	4.8
Pacific Ocean Perch	0	0	0	0	0	9.5
Other Rockfish	0	0	0	0	0.2	2.7
<b>TOTAL</b>	<b>19.0</b>	<b>58.6</b>	<b>812.7</b>	<b>2,611.3</b>	<b>3,864.0</b>	<b>13,324.7</b>
Vessels	*	3	*	19	21	48
Landings	*	3	*	93	129	520
Value (× \$1,000)	10	39	538	872	2,150	4,686

\*Data not available.

Source: ADF&G 1982.

## **Foreign Fishing**

Foreign fishing in the Bering Sea occurs year-round and is concentrated along the continental shelf edge which extends in a northwesterly direction from Unimak Pass. All foreign trawling is prohibited in the Bristol Bay Pot Sanctuary to the north of the Aleutians East CRSA, and foreign longlining is allowed in this area only beyond 12 miles. All foreign fishing was also eliminated from the recently created U.S. Fishery Development Zone in the Unimak Pass vicinity. These regulatory restrictions effectively eliminate most foreign fishing activity in Bering Sea waters adjacent to the Aleutians East CRSA. Foreign fleets do, however, enter waters in the Aleutians East CRSA when in transit, with most traffic concentrated in the Unimak Pass area.

## **Domestic Fishing**

Domestic groundfish operations are currently limited to the southern, relatively nearshore areas of the eastern Bering Sea, including waters just to the north of the Aleutians East CRSA (Map I). Most domestic harvests have been made by joint venture operations in the Bering Sea. In 1982, ten joint ventures, which utilized a maximum of 54 U.S. catcher boats, operated in the Bering Sea. Joint ventures target on a variety of species with pollock, yellowfin sole, other flounders, Atka mackerel, and Pacific cod all being important components of the catch (Table 12-6). Several large domestic factory trawlers that target on Pacific cod currently conduct successful operations in the Bering Sea groundfish fishery.

Deliveries of Bering Sea groundfish to domestic processors have been almost exclusively limited to Pacific cod (Table 12-7) with most deliveries made to processors located west of the Aleutians East CRSA. In 1982, cod fishing activity during winter and early spring was concentrated in the new Fisheries Development Zone north of Unimak Pass and around Akutan. During late spring and summer, the fishery moved eastward and a considerable harvest of cod was taken off Port Moller during the summer (ADF&G 1982).

## **Stock Conditions**

With the exception of Pacific Ocean perch and sablefish stocks, commercial groundfish stocks in the Bering Sea are in good condition (Table 12-2). Pollock biomass is stable; Pacific cod stocks have been increasing but declines are expected in the next several years; yellowfin sole populations have recovered from overfishing in the late 1950s and early 1960s and populations are expected to remain high through the mid-1980's; "other flounder" populations, especially Alaska plaice, appear to be increasing; and Atka mackerel and turbot stocks appear to be stable. Sablefish populations and catches have increased slightly since 1979 but remain at reduced levels compared to earlier years. Pacific Ocean perch catches remain at a fraction of their former abundance with no sign of improvement in stock condition (Bakkala and Low 1983).

---

# **CHAPTER 13**

## **Shellfish Fisheries**

## CRAB FISHERIES

There are extensive king and tanner crab fisheries to the north of the Aleutians East CRSA in the Bering Sea and Bristol Bay. Few residents of the Alaska Peninsula, however, participate in these fisheries because their vessels are too small to withstand the severe weather conditions found in the Bering Sea. Local residents dominate the king and tanner crab fisheries conducted on the south side of the Peninsula. The Chignik/South Peninsula harvests accounted for about 5 percent of the Westward Region's 1982-83 king crab harvest and about 19 percent of its *C. bairdi* tanner crab harvest. Interest in Dungeness crab fishing, which is limited to South Peninsula waters, has increased during the past several years.

Important fishing grounds for crab are shown on Map H. Crabbing in the Westward Region began as a supplementary fishery for salmon and halibut fishermen in the 1960's. This continues to be the case for most Alaska Peninsula crabbers who use the same vessel for both salmon and crab fishing. However, in the Bering Sea a large boat fleet specifically built for crabbing now dominates the fishery. The same vessels are used for both king and tanner crab fishing.

### Management

The Alaska crab fishery is managed by the Alaska Department of Fish and Game in state waters and the North Pacific Fishery Management Council (NPFMC) in the Fishery Conservation Zone (FCZ). No king crab and few tanner crab are taken in federal waters off the South Peninsula, but much of the Bering Sea crab fishery occurs in the FCZ. The NPFMC uses the State regulatory framework to manage the Bering Sea king crab fishery (NPFMC 1982) and a cooperative arrangement between these two agencies exists for tanner crab management (NPFMC 1981). All Dungeness crab are taken in state waters. Crab fisheries allow the harvest of mature males only; maturity is determined by carapace (shell) width. Seasons vary with fishing area and allowable catch. As effort has increased and stocks have diminished, seasons have been shortened for king and tanner crab in all areas.

### South Peninsula King Crab Fishery

The king crab fishery in the waters South of the Aleutians East CRSA occurs in ADF&G Area M (Map H). Currently, the fishery is exclusively for red king crab. The king crab season, which formerly extended from September through January, lasted only 10 days in the major production areas in 1982. The 1983 red king crab season was canceled because of low stocks and extremely low numbers of pre-recruit (sub-legal sized) males; however, fishing for brown king crab was allowed. To date no significant populations of this deep water species have been found in waters offshore of the South Peninsula (Hilsinger, ADF&G, personal communication).

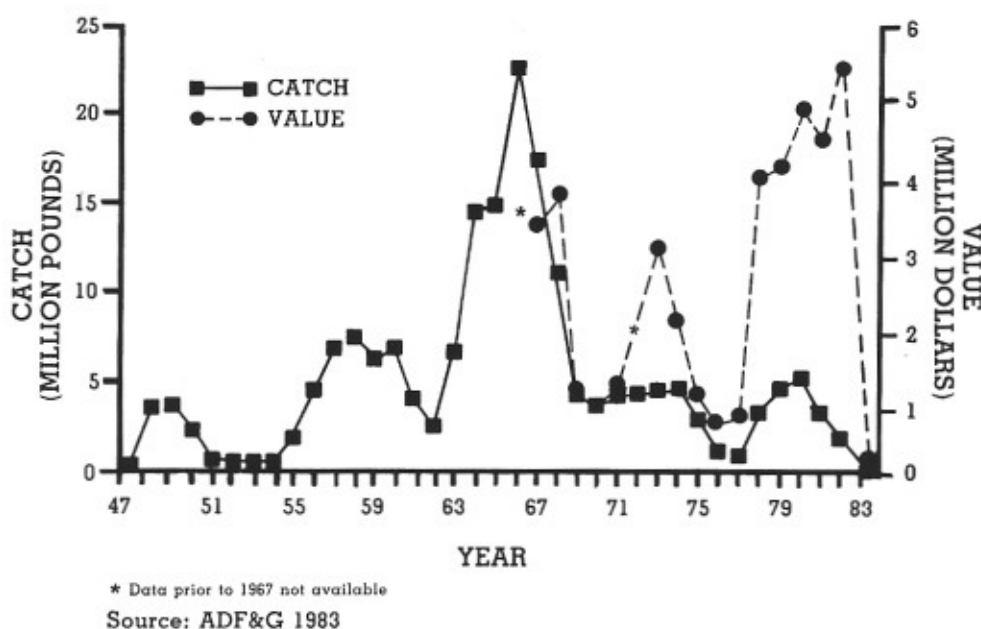
## CATCH

The South Peninsula/Chignik king crab fishery started in 1947 with a domestic trawl harvest of 141,000 pounds, then rapidly expanded (Figure 13-1). In 1961 trawl gear was prohibited and the modern-day crab pot fishery was initiated. In 1966, the king crab harvest peaked at 22.6 million pounds, with over half of that catch (13 million pounds) coming from the Unimak Bight/Davidson Bank area. In the early 1970's, the catch rapidly declined and the most productive fishing grounds shifted to the Central District with Pavlof Bay consistently being the largest producer. In 1982 Pavlof Bay accounted for 70 percent of the Area M harvest, with Morzhovoi and Belkofski Bays accounting for another 23 percent of the catch (ADF&G 1983).

Red king crab are generally caught in waters less than 100 fathoms. A few discrete, productive schools account for the greatest proportion of the catch. In general, all of the king crab schools in Area M have experienced population declines since 1979 (Hilsinger, ADF&G, personal communication). Declining catches have followed these population declines. Prospecting efforts undertaken in the deeper water of the Central District in 1982 did not locate any significant new king crab populations (ADF&G 1983).

In spite of low catches in recent years, the value of the South Peninsula king crab harvest continued to increase through 1982 because of high ex-vessel prices (Figure 13-1). The 1982 harvest was worth almost \$5.4 million dollars to the fishermen.

**Figure 13-1: Alaska Peninsula red king crab catch and ex-vessel value, 1947-1983**



## EFFORT

At the same time as catches have declined, fishing effort as measured by the number of boats participating in the fishery, has increased (Table 13-1). Alaska residents, including many fishermen from Sand Point and King Cove account for almost all Area M crab fishermen. Beginning in 1983, Area M became a "super exclusive" registration area meaning that a fisherman who fishes in this district may not participate in any other king crab fishery. This is a management attempt to limit increases in fishing effort in the area.

King crab harvested in South Peninsula waters are primarily processed at the King Cove Peter Pan Seafoods facility and at Aleutian Cold Storage in Sand Point. In addition, some crab is either processed by floating processors that enter the area for the crab season or tendered out to plants located in Dutch Harbor, Akutan, and Kodiak. Nearly all king crab is frozen and then exported from the region as leg sections to both foreign and domestic markets.

### **Bering Sea King Crab Fishery**

The Bering Sea king crab fishery harvests three species of king crab: red, blue, and brown. However, only red king crab is harvested in the Bristol Bay District (Area T) which includes the waters north of the Aleutians East CRSA.

#### **CATCH**

The Bering Sea commercial king crab harvest began in 1930 with a Japanese harvest of about 1 million crab in the waters north of the Alaska Peninsula. Relatively low levels of Japanese fishing continued through the 1939 season and then ceased. Limited U.S. exploratory fishing and processing occurred in 1940 and 1941. After World War II, crabbing resumed although domestic effort was relatively small. In 1959 domestic crabbing stopped as U.S. fishermen discontinued Bering Sea trawl operations and concentrated on the successful king crab pot fishery occurring in South Peninsula waters. Foreign effort, however, remained strong in the Bering Sea throughout the 1950's and 1960's with Japan, and beginning in 1959, the Soviet Union harvesting crab. The combined catch of these two countries peaked in 1964 when about 9 million crabs, weighing close to 64 million pounds were harvested. The Soviet Union stopped fishing for king crab in the Bering Sea in 1971, Japan in 1975.

The domestic eastern Bering Sea king crab fishery began in earnest in the late 1960's after Gulf of Alaska king crab stocks started to decline. In 1966, nine vessels participated in the fishery catching just under 1 million pounds of crab; in 1976, 141 vessels landed almost 70 million pounds of crab. The Bristol Bay red king crab fishery peaked during the 1980-81 season when 236 boats landed 130 million pounds of crab. Catches plummeted in 1981-82, then decreased still further during the 1982-83 season (Figure 13-2). The 1983-84 Bristol Bay king crab season was canceled because of severely lowered stock abundance and a lack of females with eggs. The outlook for the next several years is not encouraging (Otto et al. 1983).

The value of the Bristol Bay king crab fishery generally increased during the 1970's as both catch and price increased. The increasing prices could not, however, offset the dismal 1981-82 and 1982-83 catches, and total ex-vessel values sharply decreased from the almost \$120 million 1980 season (Figure 13-2).

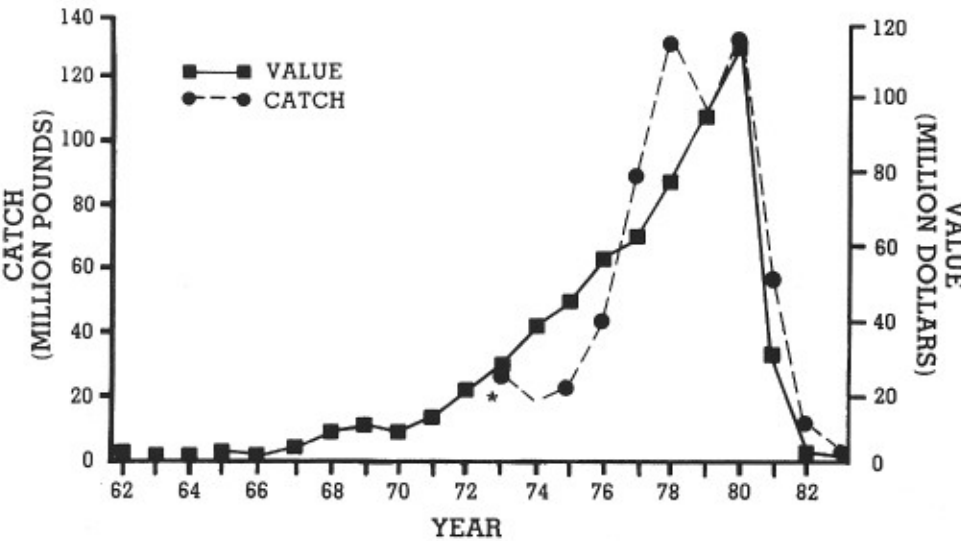
#### **EFFORT**

Effort in the Bristol Bay king crab fishery increased rapidly during the 1970's and peaked in 1979 when 236 boats participated in the fishery (Table 13-1). In 1980, Bristol Bay became an exclusive registration area. Few Alaska Peninsula vessels participate in the the Bristol Bay crab fishery. Vessels en route to Bristol Bay and other Bering Sea crabbing grounds occasionally dock at Sand Point while waiting for openings; their current impact on the economy is, however, probably minimal.

PROCESSING

King crab harvested in the Bering Sea is primarily processed outside the Aleutians East CRSA in Dutch Harbor and Akutan, although some crab has been processed at the Peter Pan facility in King Cove (ADF&G 1983). In the past, this fishery has been the major source of raw product for the King Cove plant during the fall king crab fishery. Only in recent years, as the Bering Sea catch has declined, has Area M (South Peninsula) king crab become the major source of raw material for the King Cove Plant (Hilsinger, ADF&G, personal communication). In 1983, the King Cove Peter Pan Seafoods plant did not operate during king crab season because of fishing closures in both areas.

Figure 13-2: Bristol Bay red king crab catch and ex-vessel value, 1962-1983



\* Data prior to 1972 not available  
Source: ADF&G 1983

Table 13-1: Number of vessels participating in Bering Sea and South Peninsula crab fisheries.

YEAR	FISHERY			
	Area M King Crab	Bristol Bay King Crab	S. Peninsula Tanner Crab	Bering Sea Tanner Crab
1965	35	0	0	0
1966	37	9	0	0
1967	39	20	N.A. <sup>1</sup>	0
1968	34	59	N.A.	0
1969	33	65	N.A.	0
1970	25	51	N.A.	0
1971	26	52	N.A.	0
1972	29	64	N.A.	0
1973	36	67	N.A.	0
1974	36	108	36	18
1975	37	102	44	27
1976	26	141	36	66
1977	15	130	28	83
1978	33	162	36	119
1979	68	236	48	138

# Alaska Peninsula Tanner Crab Fishery

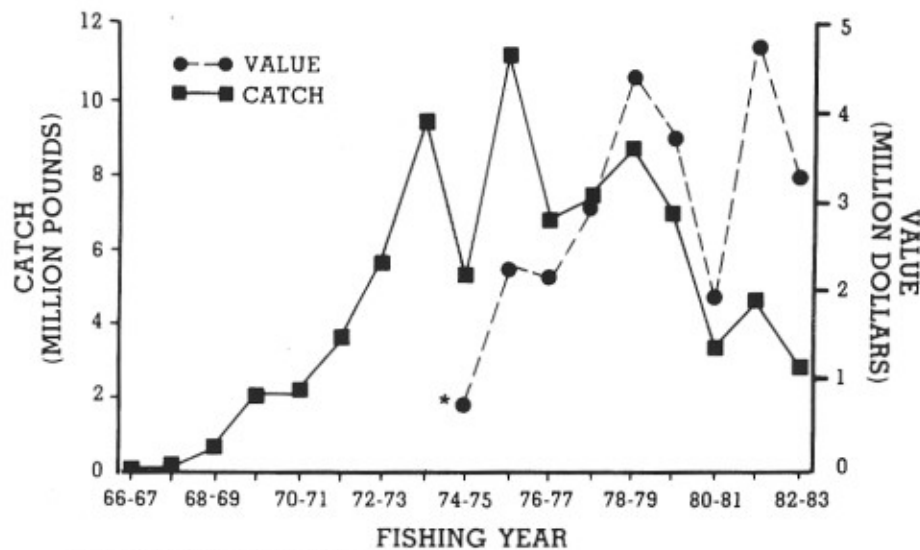
The waters to the south of the Aleutians East CRSA are all within the ADF&G Alaska Peninsula tanner crab fishing district, part of Statistical Area J. South Peninsula catches began being reported separately from Chignik catches in 1971, although prior to that time most of the combined catch came from South Peninsula waters. Only *C. bairdi* is harvested in this district. The tanner crab season which formerly lasted all year now begins on February 10 and lasts about one month.

## CATCH

Tanner crab fishing in the Alaska Peninsula District started with a small domestic harvest of 5,000 pounds in 1967 as fishermen sought to supplement declining king crab harvests. Catches steadily increased until the 1973-74 season when 9.5 million pounds were harvested. The catch peaked during the 1975-76 season at 11 million pounds. Catches then declined in response to decreasing populations (Figure 13-3). However, because of relatively low effort, catch declines did not truly reflect the magnitude of the actual population decline (Hilsinger, ADF&G, personal communication). In 1980, the stocks appeared to stabilize, allowing an annual 3 to 4.5 million pound harvest. Harvests have remained in this range since then with a 1982 catch of 4.6 million pounds and a 1983 catch of 2.9 million pounds (Figure 13-3). The most productive fishing grounds during the 1982 season were Pavlof Bay, the Belkofski - Cold Bay area, and around Sanak Island (Map H).

While catch has declined since the mid-1970's, the ex-vessel value of tanner crab harvested generally continued to increase until the 1981-82 season when the catch was worth a record \$4.8 million dollars (Figure 13-3). This was a result of recent high prices for *C. bairdi* tanner crab. In 1983, however, the price declined.

**Figure 13-3: Alaska Peninsula tanner crab catch and ex-vessel value, 1966-67 to 1982-83**



\* Data prior to 1974-75 not available

Source: ADF&G 1983, Hilsinger, ADF&G, personal communication

### EFFORT

Fishing effort in the South Peninsula tanner crab fishery has generally increased since its inception, despite declining catches after 1975-76. It was not until 1978 that fishing effort was sufficient to take the ADF&G guideline harvest for tanner crab in the District (Hilsinger, ADF&G, personal communication). During the record season in 1975-76 only 36 vessels participated in the fishery. In 1982 and 1983, 72 and 82 vessels respectively participated in the harvest (Table 13-1). Effort in this area is by Sand Point and King Cove fishermen, as well as fishermen from other areas. The proportion of the fleet consisting of non-resident fishermen has recently increased (Hilsinger, ADF&G, personal communication). After the 1983 season, the Alaska Peninsula was made a super-exclusive registration area by the Alaska Board of Fisheries. However, a similar action was not taken by the NPFMC for federal waters; hence the full effect of this regulation on managing fishing effort cannot yet be evaluated.

### PROCESSING

Most of the South Peninsula tanner crab harvest is processed by either Aleutian Cold Storage in Sand Point or Peter Pan Seafoods in King Cove. All tanner crab are frozen for export from the region. Tanner crab has both foreign and domestic markets.

### Bering Sea Tanner Crab Fishery

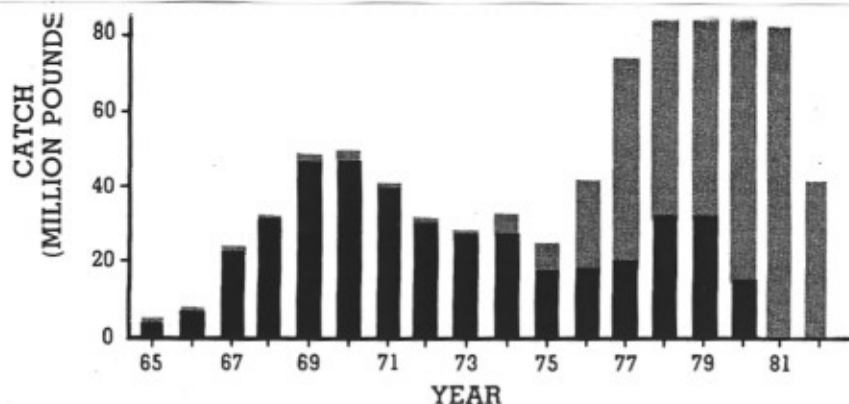
The waters to the north of the Aleutians East CRSA are included in the Bering Sea tanner crab fishing district. Both species of tanner crab — *C. bairdi* and the smaller *C. opilio* — are harvested in this area. *C. opilio* is concentrated in areas north and west of the Aleutians East CRSA, while the major *C. bairdi* fishing grounds are just off Unimak Island and the lower Northern Peninsula. During 1984, tanner crab season begins on February 15 and may last into July.

### CATCH

The commercial harvest of tanner crab in the Bering Sea began as both foreign and domestic crab fleets looked to supplement their king crab fishing activities. The Japanese first landed tanner crab in 1953 in the Bering Sea, however, catches were very small (approximately 550,000 crabs) and fishing effort was limited. Between 1953 and 1964, tanner crab continued to be harvested by Japanese and Soviet fleets that were concentrating on king crab. Beginning in 1965, these fleets started to target on *C. bairdi* tanner crab, as bilateral agreements with the United States restricted their harvest of king crab and encouraged the exploitation of tanner crab as a substitute (BBCMP 1983). In 1965 approximately 1.7 million crab were taken by the foreign fleets. The fishery expanded rapidly and, in 1968, domestic fishermen also began harvesting tanner crab, although the catch was incidental to king crab harvests until 1974. By 1969, quotas were imposed on the foreign catch of *C. bairdi*, resulting in increased effort being directed to the smaller *C. opilio*. Soviet fishing ended in 1971, but Japan continued to harvest *C. opilio* in the Bering Sea through 1980 (Figure 13-4).

**Figure 13-4: Estimated total annual tanner crab catches from the Bering Sea, 1965-1982**

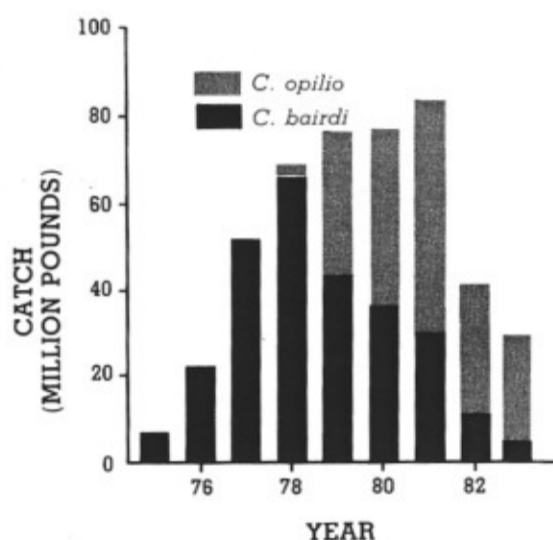
120 }  
■ DOMESTIC CATCH



Source: ADF&G 1983

The directed domestic tanner crab fishery began with *C. bairdi* harvests off the Alaska Peninsula and around the Pribilof Islands in 1974. The *C. bairdi* fishery continues to concentrate in these locations. The fishery rapidly expanded and peaked with a 26 million crab (66 million pound) harvest in 1978. The stocks and harvests then began to decline and by 1983 *C. bairdi* harvests amounted to only 5 million pounds (Figure 13-5). In response to the declining *C. bairdi* stocks, fishermen began targeting on the smaller, less valuable *C. opilio* crabs. Significant (about 1.7 million pounds) landings were first reported in 1978. Catches rapidly increased, and peaked in 1981 with a catch of over 52 million pounds. Catches in 1982 declined markedly with only 29 million pounds taken (ADF&G 1983). Catches in 1983 were equally low with only about 25 million pounds harvested (Otto et al. 1983).

Figure 13-5: Species composition of domestic tanner crab catches from the Bering Sea, 1974-1983

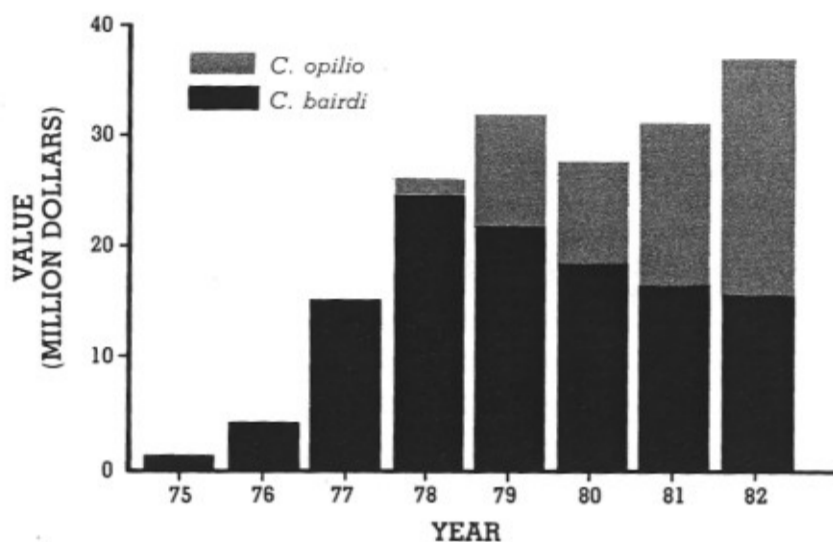


Source: ADF&G 1983

The outlook for the Bering Sea tanner crab fishery is only fair and it is apparent that harvests will be lower than those taken in the 1970's. *C. bairdi* stocks continue to be depressed. The 1983 NMFS Report to the Industry revises earlier optimistic statements regarding increasing abundance of legal sized crabs. *C. opilio* stocks appear to be stabilizing, but at lower levels of abundance and smaller sizes than in the 1970's. Small increases in *C. opilio* abundance are predicted for the next several years (Otto et al. 1983).

While tanner crab catches have declined over the last several years, the value of the fishery has remained steady or increased as the value of tanner crab, especially *C. opilio* has risen dramatically (Figure 13-6). The 1982 catch was worth nearly \$37 million to fishermen, with the *C. opilio* catch accounting for the largest proportion of the value for the first time.

**Figure 13-6: Ex-vessel value of the domestic tanner crab harvest in the Bering Sea by species, 1975-1982**



Source: Bristol Bay Cooperative Management Plan 1983

#### **EFFORT**

Effort, as measured by numbers of vessels, increased steadily from 1974 through 1981, and declined somewhat in 1982 and 1983 (ADF&G 1983). Fishing effort for *C. opilio* is usually somewhat less than for *C. bairdi* (Table 13-1).

#### **Dungeness Crab**

Dungeness crab is harvested in the waters off the South Peninsula. ADF&G reports include combined catches for the South Peninsula (within the Aleutians East CRSA) and Chignik Districts (outside the Aleutians East CRSA) with the majority of crabs coming from the South Peninsula District (69 percent of the 1982-83 catch). Historical Dungeness catches have been sporadic (Figure 13-7), beginning with a record harvest of over 1.2 million pounds in 1968. During the last two years interest in this fishery has again increased. The 1982-83 season produced 536,000 pounds of Dungeness crab worth \$402,000 from South Peninsula waters. The 1983-84 harvest will probably exceed the previous year's catch (Hilsinger, ADF&G, personal communication).

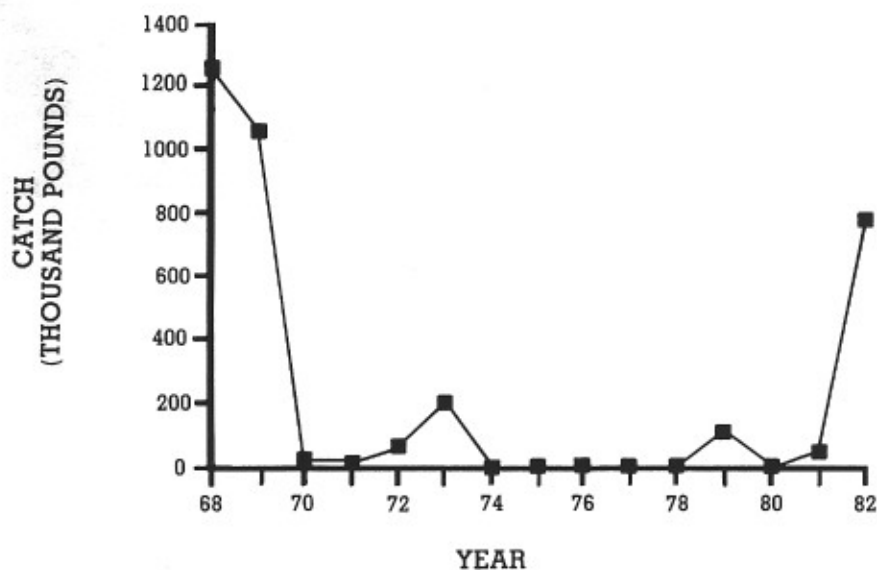
previous year's catch (Hilsinger, ADF&G, personal communication).

Although Dungeness crab season opened on May 1 in 1982, there was no activity until July when a single landing was made. Fishing peaked in November when 10 vessels made 27 landings. Fishing ceased by the end of December, although the season remained open until February 1 (ADF&G 1983). Most Dungeness fishermen are from outside the Aleutians East CRSA, although two local vessels participated in the fishery in 1983 (Hilsinger, ADF&G, personal communication).

In the past, Dungeness crab had to be transported to Kodiak to be sold. This was a problem as fishermen consistently had large dead losses on the long trip. Both Aleutian Cold Storage in Sand Point and Peter Pan in King Cove now process Dungeness crab so that marketing is no longer a problem. Dungeness crab are frozen and exported from the region, primarily to domestic markets.

Very little is known about the size of the Alaska Peninsula Dungeness crab stock or the magnitude of the fishery that could be supported. It is almost certain, however, that interest among fisherman in this fishery will continue to grow over the next few years as alternatives to king crab are sought.

**Figure 13-7: Alaska Peninsula Dungeness crab harvest, 1968-1982**



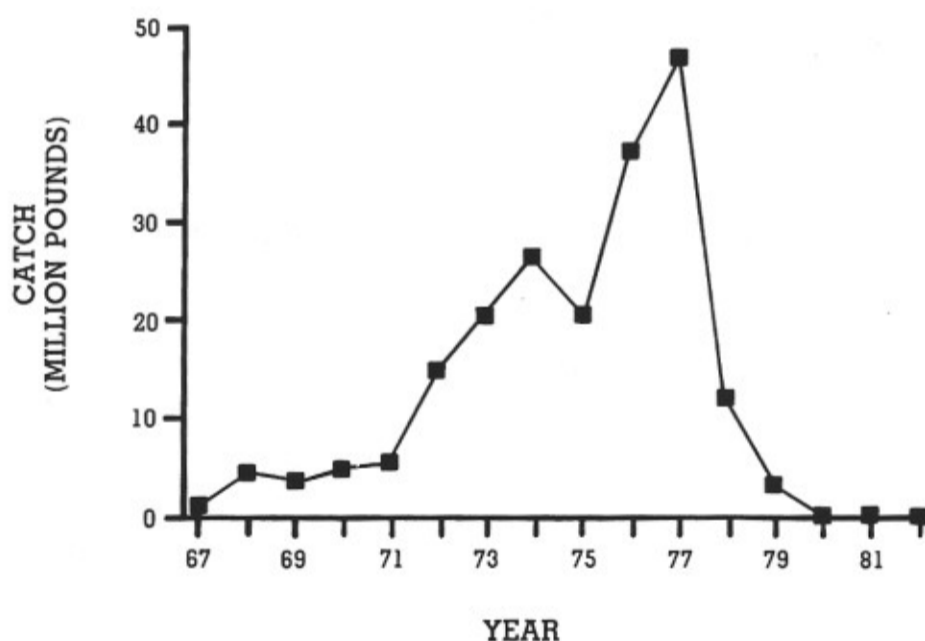
Source: ADF&G 1983

## SHRIMP FISHERIES

Alaska Peninsula shrimp fishing started in the spring of 1968 when 900,000 pounds were delivered. Seasonal catches in the South Peninsula District climbed rapidly, peaking during the 1977-78 season with a harvest of just over 45 million pounds. Stocks then dropped dramatically and, starting with the 1979-80 season, some South Peninsula areas were designated as severely depressed and were to be opened only by emergency order. The trend of declining stocks continued until all South Peninsula sections were closed in 1980 (Figure 13-8). The grounds remained closed for the 1981-82 season. For the 1982-83 season, all offshore waters of the South Peninsula were open to shrimping to allow exploration. No harvests were reported suggesting a continuation of the severely depressed state of the stocks (ADF&G 1983). No shrimp openings are planned for the 1983-84 season and there are no indications of stock recoveries in the near future.

Shrimping in the Alaska Peninsula was conducted by trawlers, primarily from the Kodiak area and other locations outside the Aleutians East CRSA. Several species of the Pandalidae family were harvested, although pink shrimp was by far the most abundant species. Historically important shrimping grounds include Pavlof Bay, where over 25 million pounds were harvested during the 1977-78 season, Stepovak Bay, Unga Straits, West Nagai, and Morzhovoi Bay (Hilsinger, ADF&G, personal communication). Catches were processed at existing plants within the region, as well as at a presently closed shrimp plant located at Squaw Harbor.

Figure 13-8: Alaska Peninsula shrimp harvest, 1967-1982



Source: ADF&G 1983

## OTHER FISHERIES

### Scallop Fishery

The Alaska Peninsula scallop fishery takes place mainly in the Chignik District, outside the Aleutians East CRSA. Large portions of the South Peninsula, including Unimak Bight and all the bays, are closed to scallop fishing to prevent damage to crab stocks and conflicts with crab gear. Open areas within the South Peninsula District appear to have only limited scallop resources (ADF&G 1983).

The South Peninsula District scallop fishery began in 1975 when 2,508 pounds of meat were landed from the Shumagin Bank area. Since then, catches have been very small and sporadic. In 1982, 33,358 pounds of meat were produced during the period from February through August. Some exploratory scalloping was conducted in closed areas of the South Peninsula District in 1982, but no large populations were found and some conflicts with crab gear during the tanner season were reported (ADF&G 1983). All vessels participating in the South Peninsula scallop fishery are from outside the Aleutians East CRSA. No processors located in the Aleutians East CRSA currently process scallops.

### **Clam Fishery**

While scattered razor clam beds exist on several beaches both on the North and South Peninsula (Map D), their commercial potential is minimal. More significant, but as yet unexploited, clam resources are available in Bering Sea waters to the north of the Alaska Peninsula.

The Alaska surf or pinkneck clam and the Great Alaskan Tellin clam both have areas of concentrations in the waters north of the Alaska Peninsula with their centers of abundance stretching from Port Moller to Ugashik Bay (Map D). The precise size of the resource is unknown; however, an estimate of exploitable biomass for the major population of Alaskan surf clams is 329,000 + 52,000 mt (Science Applications, Inc. 1981).

The potential fishery for both clams would probably be concentrated to the east of the Aleutians East CRSA but would include the Port Moller area. Large boats capable of pulling heavy dredges would be needed to harvest the resource. The fishery has not developed because of both prevailing economic conditions and potential conflicts between a large-scale clam fishery and other resources such as marine mammals and existing fisheries.

---

## **CHAPTER 14**

# **The Aleutians East Coastal Resource Service Area: An Historical Description**

---

### **EARLY ALEUT HISTORY**

The history of human settlement of the Aleutians East CRSA apparently began between 5,000 and 10,000 years ago when the ancestors of the Aleuts settled in the Aleutian area. By this time the Bering Land Bridge, which allowed settlement of North America by Siberian peoples, was submerged and the coastline of Alaska was similar in configuration to that of the present day. The earliest known artifacts from the region are dated at about 8,000 years and come from Anangula Island near Umnak Island. There is some disagreement about whether or not these artifacts are those of the early Aleuts or some other people who left the Aleutians before the Aleuts arrived. There is also disagreement among ethnohistorians regarding the origins of the people inhabiting this area. That they share an Asiatic origin with other Native groups in North America is clear; however, the precise timing and evolution of native occupation of the Alaska Peninsula and Aleutian Islands is not fully understood.

Some researchers contend that the ancestors of the Aleuts entered the region from the east about 8,000 years ago, traveling both by boat (bidarka) and by foot. Unimak Island is regarded as a possible point of entry. Here they remained relatively isolated from Eskimo and Indian populations, developing their own language and society. Other researchers theorize that actual Aleut occupation began more recently, around 5,000 years ago, and that earlier settlements do not represent a continuum of occupation by one ethnic group. Some historians have suggested that settlement came from the north and east. Even Aleut tradition does not shed any light on their origin as a distinct ethnic group; records by Father Veniaminov indicate that some Aleuts believed their ancestors came from the west while other traditions indicated an eastern origin. More research and investigation is needed before one theory can take precedence over another.

The Aleut peoples first became known to the Western World in the eighteenth century during the years of Russian occupation and expansion. Descriptions in documents of the time reveal a picture of a well-organized aboriginal people highly dependent on the sea for their livelihood. Fish, marine mammals and marine invertebrates furnished most of the Aleuts' food, shelter, weapons, tools, and adornments. Aleuts lived in villages usually consisting of one or more extended families. They built semi-subterranean dwellings which usually housed more than one family. Heat was derived from lamps which burned seal oil or whale blubber. Furnishings were simple and consisted mainly of mats and baskets woven from grass. Aleut men engaged in fishing and hunting both marine and terrestrial mammals and birds. Women gathered berries and other vegetation and seafood such as blue mussels and clams.

Clothing was made from animal skins, including birds. Women wore long parkas made from seal or sea otter skins; there is some indication that sea otter clothing was worn primarily by higher ranking women. Men's parkas were made from bird skins, worn either with feathers in or out depending on the need for warmth. Waterproof garments were sewn from sea lion guts or halibut bladders. The Aleuts used bones, feathers, bird beaks, and fur strips to decorate their clothing and to make jewelry. They wore ornaments in their noses, ears, and lower lips and often tattooed their faces and hands.

There were three recognized classes in Aleut society: honorables, middle class, and slaves. The honorables consisted of the chief and his extended family and friends. The middle class derived from free slaves and other "non-honorables." Slaves were taken regularly during raids on neighboring villages. Children of slaves were often not considered to be slaves and were integrated into the middle class of the village.

Food and other goods were usually shared on an equal basis throughout the village; greediness and hoarding were not acceptable behavior. Despite this egalitarian approach to material possessions, there were varying levels of wealth in the village. Honorables got a larger share of slaves and precious stones, the usual booty of war, and therefore were considered to be wealthier. Status, however, was based on demonstration of valued qualities such as patience, generosity, self-sufficiency, and bravery rather than on possessions alone.

Within the village, Aleuts strived for cooperation and avoidance of conflict. Public censure for unacceptable acts usually took the form of shunning or mocking remarks. In conflicts between villages, however, the Aleuts were violent and brutal. Raiding parties frequently would murder most of a village's inhabitants and enslave the survivors.

Villages were presided over by a chief and elders. These may have been hereditary positions or may have been chosen from among the honorables. Shamans oversaw the spiritual life of the Aleuts and were considered to be endowed with powers to cure physical ills. Daily life was filled with rituals which were an effort to combat the forces of nature, particularly the sea which influenced nearly every aspect of daily life. Special observances were associated with major events such as birth, puberty, and death.

Marriages were frequently arranged by elders and, though no marriage ceremony occurred, bridegrooms were expected to give presents to the bride's family and possibly live with and work for them for a few years. Men and women both could take more than one spouse. Children were trained primarily by their maternal uncles and often would stay with them if their parents divorced. Aleuts were kind and generous to their children but also trained them to be self-sufficient and stoic in adversity.

## RUSSIAN INFLUENCE

The Russians, under Vitus Bering, reached the Aleutians in 1741. The furs they took back to Russia stimulated numerous expeditions to Alaska through the remainder of the eighteenth century. The Aleuts initially resisted the Russian invasions during this time but eventually were overcome in a series of brutal massacres. Diseases introduced by the white man also took their toll of the Aleuts and in less than one hundred years the Aleut population decreased from approximately 12,000 to less than 1,500. Russia established the Russian-American Company in 1799 to harvest sea otter and seal furs. The Russians relied upon the Aleuts' expertise in obtaining the furs and required the Aleuts to work for the company. This usually meant that the Russians commandeered up to half of the adult males in the village as hunters. The village chief was allowed to retain his position but was expected to cooperate with the Russians and ensure that their orders were carried out. Many Aleuts were relocated to areas the Russians wanted exploited for furs.

The Russians introduced Christianity to the Aleutians through the Russian Orthodox Church. Father Veniaminov established the first church school in 1825 at Unalaska and was a profound influence on the Aleuts during his ten years in Alaska. He approached the conversion and education of the Aleuts with an attitude quite enlightened for the time. It was he, in cooperation with a local chief, who developed a written language for the Aleuts. Classes and Church services were conducted both in Russian and Aleut.

The purpose behind establishing schools in the Aleutians was to train the Aleuts in skills needed by their Russian overseers. The Aleuts were trained to be blacksmiths, carpenters, bricklayers, bookkeepers, etc. Attempts to eradicate Native culture were not made because, as long as the Aleuts were performing their jobs adequately, the Russian-American company did not concern itself with the organization of Aleut lifestyle. Indeed, Father Veniaminov encouraged, rather than discouraged, Native music and arts. The Russian Orthodox Church was fairly readily accepted by the Aleuts and became an important factor in their lives. Several reasons have been advanced for the acceptance of the church by the Aleuts: 1) joining the church exempted the people from paying tribute to the Russians for three years; 2) the Russian priests suppressed Native religious ceremonies and practices while allowing other aspects of their culture to be retained; 3) the church adapted some of its practices to the Aleut customs; and 4) the power of the Shamans declined when they were unable to combat the diseases introduced by the white man.

The Russians also influenced the family structure by discouraging polygamy and polyandry and encouraging the nuclear family. The barter system was introduced; Aleuts were required to trade their furs for merchandise at the company stores. At the time of the sale of Alaska to the United States, the Aleuts had churches and schools; many were able to read and write and some were highly educated. There were Aleut accountants, navigators, and even physicians. However, the Aleuts as a whole still retained much of their traditional culture and remained dependent upon the sea for food, shelter, and other necessities.

## AMERICAN INFLUENCE

In 1867, Russia sold her American colonies to the United States of America. Russia's American interests were becoming less economically viable and internal strife was reducing national interest in overseas colonies. The United States enterprises in the Aleutians relied upon volunteer labor; consequently, some Aleuts elected to pursue a subsistence lifestyle while others worked for wages. Company stores provided Aleuts with an opportunity to purchase a greater variety of goods than previously available from Russian stores.

American missionaries, settlers, and teachers brought with them the "Protestant ethic" which emphasized cleanliness, hard work, and discipline. They vigorously attacked the Native lifestyle, discouraging the use of the Aleut language and traditional foods and houses. The Aleuts became more and more absorbed into the American way of life and dependent upon a wage economy.

Until the end of the nineteenth century, the mainstay of the Aleut economy was the sea otter. By 1900, the otter populations had declined and the cod fishery had taken its place. In 1911, the United States government enacted a treaty with Great Britain, Russia, and Japan to protect the fur seal and sea otter. The cod fishery centered in the Alaska Peninsula-Unimak Island-Shumigan Islands area. Fishermen, predominantly Scandinavian, immigrated to the region and many married Aleut women and remained there.

The cod fishery reached its peak around 1918 and declined steadily until it was discontinued in the 1950's. A herring fishery was established in the 1920's and continued until shortly after World War II. Also during the 1920's, fox farming and trapping became very important in the Aleutians as demand for fox furs rose. Foxes had been introduced to some islands as early as 1898. This enterprise, however, declined in the 1930's and was discontinued in the 1940's due to a drop in fur prices. The salmon fishery, which developed around 1900, remains the basis of the Aleutians East CRSA economy to the present.

During World War II, American military forces were stationed throughout the Aleutians; however, their presence in the Aleutians East CRSA (with the exception of Cold Bay), was relatively brief and had little impact compared to areas further west. Aleut inhabitants of areas to the west of Unimak Island were evacuated from their villages in 1942 and were not returned to their homes until 1945.

From 1900 to the 1970's, the lifestyle of the Aleuts remained relatively unchanged. In 1971, the Alaska Native Claims Settlement Act was signed into law and the Native people of the Aleutians were able to regain control over some of their aboriginal lands. Corporations were established to oversee the land and the cash entitlements. In 1976, the 200 mile limit for foreign fishing was established by the Fishing Conservation and Management Act. This action has helped protect the fishing grounds along the Aleutian Islands and Alaska Peninsula from foreign exploitation and encourage investment by residents in the fishing industry.

## **COMMUNITY HISTORIES**

In the days preceding the Russian occupation of the Aleutians, the Aleuts had established a number of villages in the area encompassed by the Aleutians East CRSA. The Russians had displaced populations of Aleuts to other areas in the region to exploit the sea otter.

After the sale of Alaska to the United States, fishing became the mainstay of the area's economy. New communities sprang up in association with fish processing plants and residents of the area abandoned established villages to move to communities offering employment and a greater variety of goods and services. Today there are five viable communities in the Aleutians East CRSA: Sand Point, Cold Bay, King Cove, False Pass, and Nelson Lagoon. Belkofski, the sixth community, is experiencing a decline in population from which it is unlikely to recover.

### **Sand Point**

The community of Sand Point was founded in 1887 as a supply station for ships involved with the burgeoning cod fishery in the Bering Sea and Shumagin Islands. In the early 1900's, fox farming was an important business in the Shumagins and people associated with it were attracted to Sand Point. During this time, gold was discovered on Unga Island and prospectors arrived in the village of Unga. As mining declined in the 1930's, in order to find wage employment, Unga residents migrated to Sand Point in the period between 1950 and 1970. The harbor at Sand Point was superior to that at Unga and allowed anchoring of the large vessels required to compete in the fisheries. Previously, vessels at Unga had to be beached during the winter, a requirement that is impractical for purse seiners and gillnetters. Residents of Pavlof Harbor (Sanak) and Wosnesenski also relocated to Sand Point.

Sand Point continued to increase in importance as a center for the fishing industry throughout the early twentieth century. In 1931, a salmon cannery was built by Alaska Pacific Salmon. It no longer functions as a cannery and is owned by Sand Point Fisheries. Peter Pan Seafoods eventually built another processing plant in Sand Point which currently provides only support services for fishermen. Aleutian Cold Storage processed halibut in the community beginning in 1946 and added salmon processing in 1980. One reason for Sand Point's continued successful existence is that its processing facilities have always been more diversified than those in other communities.

Government services were located in Sand Point (Chapter 16) because of its steadily increasing population and this, in turn, stimulated more people to relocate to Sand Point. Sand Point remains today a very important headquarters for the fishing industry in southwest Alaska.

Approximately 75 percent of the residents of Sand Point are Aleut. Many are descendants of Scandinavian fishermen who arrived in the early part of this century and settled in the area with Aleut wives.

## **Cold Bay**

Cold Bay is the newest of the communities in the Aleutians East CRSA. Fort Randall was built by the United States military during the Aleutian campaign against Japanese invasion in World War II. The community grew up around the Fort and the airstrip which was built in 1942. However, archeological evidence indicates that the area was in use by Native people long before the twentieth century.

The Fort was abandoned by the military after the war and, in the 1950's, Reeve Aleutian Airways assumed control of the airstrip. Control was eventually passed to the Federal Aviation Administration and is currently held by the State of Alaska. An Air Force DEW line site was established at Cold Bay in 1958. In the late 1970's this installation was still maintained as a forward observation post for the military.

Flying Tigers, Inc. constructed facilities near the airport in 1960 under a military transportation contract. During the war in Southeast Asia, Cold Bay was used extensively in transporting men and material to and from the war zone. The Izembek National Wildlife Refuge was established in 1960 and today is part of the Alaska Maritime Refuge System under U.S. Fish and Wildlife Service. The USFWS and University of Alaska have maintained research facilities at Cold Bay since 1963.

The population of Cold Bay is predominantly white with smaller percentages of Aleut, Eskimo, Indian, and Black residents.

## **King Cove**

King Cove, like Sand Point, was established as a result of the fishing industry. A salmon cannery was located there in 1911 by Pacific American Fisheries. The cannery attracted fishermen from northern Europe, many of whom married Aleut women and settled at King Cove. Other Aleuts, drawn by wage employment, migrated to King Cove from Native settlements such as Sanak Island, Thinpoint, Morzhovoi, and Ikatan. Belkofski has contributed significantly to the population of King Cove; in 1976, eight Belkofski families moved to King Cove when their school was closed.

Between 80 to 90 percent of the population of King Cove is of Aleut origin. Many of the residents have either Russian or Scandinavian forebears as is reflected in their surnames. The economy of the town remains focused on fishing and fish processing.

## **False Pass**

False Pass is the only community located on Unimak Island. When the Russians moved into the Aleutian Islands, there were several Aleut villages on Unimak Island. These people apparently existed in a loose organization with Aleuts from Sanak Island. Because they were of a warlike nature, other Aleuts in the vicinity feared the Unimak-Sanak people. The Aleuts fiercely resisted the Russians; in 1759 they destroyed four Russian ships and killed 200 men overwintering in Bechevin Bay. Eventually, the Russians subdued the Unimak Aleuts who were either relocated to other areas or congregated of their own accord at Morzhovoi and on Sanak Island.

Under American influence in the late 1800's, cod fishing stations were established on Sanak Island and at Ikatan on Unimak Island. In 1916 a salmon processing plant was built at Morzhovoi by Pacific American Fisheries. The site of present day False Pass was homesteaded by John Gardiner. On land acquired from Gardiner, P.E. Harris constructed a cannery in 1918 and the Morzhovoi cannery was eventually closed. During the 1930's through the 1950's, villagers from Ikatan, Morzhovoi and Sanak Island migrated to False Pass, although many from those villages also settled in King Cove.

False Pass remains a small community with a few services (Chapter 16). It is still dependent upon fishing for its livelihood. Over 90 percent of the residents are Aleut; some have Scandinavian ancestors.

### **Nelson Lagoon**

Nelson Lagoon was established in 1906 when a salmon saltery was built in the vicinity; although the Nelson Lagoon area had been traditionally used as a fish camp by Aleuts. The saltery was not successful and, in 1915, a cannery was built on Egg Island. This cannery operated for only two years. Family groups which had previously been scattered throughout the Herendeen Bay area gradually began to congregate at the Nelson Lagoon Village site. By 1932, there were six houses on the spit. Several of the settlers were Scandinavians with Aleut wives. The population of Nelson Lagoon has remained fairly stable in recent years. Most people in the village are of Aleut-American, Aleut-Scandinavian, or Aleut-Russian derivation.

### **Belkofski**

Belkofski was established in 1823 when Russians transported Aleuts, primarily from Sanak Island, to the area to exploit sea otters. During the nineteenth century, Belkofski was probably the most affluent village in the Aleutians. A large Russian Orthodox Church was constructed and Belkofski was established as the headquarters for the Church in the Aleutians. The village had several stores and relatively easy access to goods from the west coast of the U.S. When the sea otter populations declined, the fishing industry did not locate in the area because the village lacked a harbor or suitable anchorage. Belkofski residents did, however, participate in fox farming and trapping during the 1920's and 1930's. After that industry declined, the men in the village turned increasingly to seasonal employment elsewhere and the population began to drift away to more viable communities such as King Cove. The most recent population shift occurred in 1976 when the Belkofski school was closed and eight families moved to King Cove.

---

## **CHAPTER 15**

# **Archaeological Resources**

---

### **INTRODUCTION**

Very little is known about the cultural resources and archaeological sites of the Aleutians East CRSA. A number of inventories have been conducted at particular sites over the past decade; however, there is no comprehensive inventory of the cultural, historic, and archaeological resources of the region. In July 1973 archaeologist Allen P. McCartney summarized the situation:

*"...This region of southwestern Alaska — South of the Alaska Peninsula — where such portentous contact occurred between Russians and Aborigines still remains a void on anthropological maps. Practically nothing about the early Peninsula Eskimo and Shumagin lifeways has been recorded since, ...1936 by an expedition naturalist, Stellers... and information about the prehistoric period is still almost totally lacking."*

As a result, the inventory that exists is incomplete and it is believed that available archaeological information for the Aleutians East CRSA may not adequately recognize significant archaeological and cultural resource sites.

## DOCUMENTATION OF SITES

The legal basis for identifying an archaeological site is found in federal and State laws.

### Federal Laws

- **1906 Antiquities Act:** requires protection of any "historic or prehistoric ruin or monument, or any object of antiquity, situated on lands owned or controlled by the Government of the United States."
- **1935 Historic Sites Act:** "authorized the Secretary of Interior to take a leadership role in the protection of cultural resources and to coordinate interagency, interdisciplinary, and intergovernmental efforts for cultural resources preservation."
- **1949 and 1966 National Historic Preservation Act of 1966:** expanded the National Register of Historic Places to include those of local, state, and regional significance, involved state and regional governments in the planning/preservation process, and established the Advisory Council on Historic Preservation to monitor the activities of all federal agencies affecting cultural resources.

Other miscellaneous acts were passed that required specific attention be paid to cultural resources where large projects using federal funds were undertaken.

- **1969 National Environmental Policy Act:** includes concern for cultural resources.
- **1971 Executive Order 11593:** established that federal policy is to:

"1) administer cultural resources in agency control in a spirit of stewardship and trusteeship for the future; 2) conduct agency operations to maintain, restore, and preserve cultural resources on Federal land; and 3) conduct agency operations in such a way, in consultation with the President's Advisory Council on Historic Preservation, to assure that agency plans contribute to preservation of non-Federal cultural resources"

The Executive Order integrated cultural resource laws and regulations into a uniform policy, and charged all land-controlling federal agencies to inventory all cultural resources in their domain to determine their eligibility for the National Register of Historic Places.

### **State Laws**

- **Alaska Historic Preservation Act**, established the Alaska Heritage Resources Survey (AHRs)

As a result of these laws, a number of programs have been established to document cultural and historic sites in the State and to consider this information when making land management decisions.

## **SITES IN THE REGION**

There are two ongoing projects to document archaeological and cultural sites in the Aleutians East Region: the Alaska Heritage Resources Survey and the federal 14 (h) site inventory.

The Alaska Heritage Resources Survey documents traditional features and locations which display definite physical remains. This survey, as depicted on Map J, includes nearly 150 sites in the Aleutians East area.

Given the confidential nature of this information, specific site locations are not provided in order to protect their integrity. The sites are characteristically close to the ocean, in protected areas near fresh water, or near a resource important for subsistence needs. Descriptions of the sites include "appearance of tent depressions, cache pits, old village site, subsistence use, abandoned trapping and/or hunting cabin, house pits, charcoal stained hearth," etc. A complete documented description of each of these sites is available from the State Department of Natural Resources.

The need for federal documentation of historic sites was increased by the Alaska Native Claims Settlement Act. Section 14 (h) 1 of the Act provides that the Secretary of Interior "may withdraw and convey to the appropriate Regional Corporation free title to existing cemetery sites and historical places." As a result, an inventory was conducted in 1976-77 and approximately 65 Section 14 (h) 1 sites were identified in the Aleutians East region.

Federal review of cultural area historic sites will continue. Funding and staff availability have prevented the Bureau of Indian Affairs Realty Office from completing a comprehensive survey of the area. Such a survey is planned for the summers of 1984 and 1985 as funding permits.

The sites are significant because they give evidence of historic lifestyles and activity patterns of residents of the Aleutians East CRSA. Further examination of the artifacts and information provided at these locations will provide insight into the cultural groups which inhabited the area. Virtually all of the coast of the Aleutians East CRSA appears to have been visited or used throughout the historical period. The cultural sites highlight the dependence of native lifestyle patterns on marine fish and wildlife, resources in proximity to fresh water, and availability of harvestable terrestrial resources.

Available information describing the cultural, archaeological, and historic resources of the Aleutians East CRSA is incomplete. In addition, confidence in the accuracy of the information for particular sites varies considerably depending on its original source and the effects of data transfer from one document to another. AHRs conducts a ground check before including a particular site in the survey catalog. While this helps assure the validity of cataloged sites, apparently the inventory is not comprehensive.

The delineated areas of traditional land use or cultural sites may vary according to interpretation of evidence by researchers due to periodic changes in the distribution of resources. The inventorying of archaeological sites has been sporadic with varying emphases, purposes, and methods. Although Map J is recognized as incomplete, it does illustrate important prehistoric and historic sites in the Aleutians East CRSA.

---

## **CHAPTER 16**

### **Community Infrastructure**

---

#### **SAND POINT**

##### **Location**

The City of Sand Point is located on the west side of Popof Island on Popof Strait. The island is part of the Shumagin Islands which lie southwest of the Alaska Peninsula between Pavlof and Stepovak Bays. The City is shown on Map K.

##### **Population**

1983 Sand Point City Census = 903 permanent residents, 1980 U.S. Census = 625 permanent residents, 150 to 225 seasonal residents.

##### **Economy**

Commercial fishing and processing are the major sources of income for Sand Point, accounting for 85 percent of the community's employment (City of Sand Point 1981). Although the settlement was started in 1887 as a processing station for cod, the primary species currently harvested are salmon. King crab, tanner crab, dungeness crab, halibut, and herring are also harvested. Many vessels operating out of Sand Point are equipped to harvest salmon in the summer and crab during the winter. A total of 118 permits for purse seine, drift gillnet, and set gillnet salmon fishing were based in Sand Point in 1980, more than in any other Aleutians East CRSA community. Aleutian Cold Storage processes seafood in Sand Point year-round, employing approximately 120 employees during the summer peak of salmon season. Peter Pan Seafoods operates a fish buying station and fishermen support services in Sand Point during salmon season. Approximately 20 local residents are employed in the processing sector. Government (local, state, and federal) and local businesses employ the remaining work force in Sand Point. Local businesses include a general store, bank, cafe, tavern, motel, taxi, vending company, gift shops, and air charter and airline companies. Subsistence is also an important part of the community's economy and lifestyle.

## **Government**

Sand Point has been incorporated as a first-class city since 1978 and has a local government consisting of a mayor, city council, planning commission, and city staff. The city provides such services as water, sewer, and small boat harbor, including a marine travel lift and dock.

The State of Alaska maintains the airport, Alaska Department of Fish and Game employees, and a state trooper in Sand Point. Law enforcement is provided by the state trooper who also serves other regional communities. Fire protection is organized under a volunteer system. The federal government maintains a post office in Sand Point. The magistrate, who is stationed in Cold Bay, also has an office in Sand Point.

## **Land Ownership**

The majority of land within Sand Point is owned by Shumagin Corporation. Other land owners are Aleutian Cold Storage, the City of Sand Point, Peter Pan Seafoods, and private individuals. The State of Alaska owns the airport and a small amount of land which houses the Department of Fish and Game office and warehouse.

## **Education**

Sand Point City School serves kindergarten through the twelfth grade and is controlled by a five member, locally elected school board. The original school was built in 1952 and has undergone several additions. A new school with a swimming pool was built in 1983. In 1983, 107 students were enrolled in the school. The district employs 14 teachers and 5 other employees, e.g., bus driver, custodians, librarian, and administrative personnel.

Sand Point also has a rural education center affiliated with the University of Alaska Division of Community Colleges.

Federally funded Indian Education and Johnson O'Malley Committees (both locally elected) are charged with oversight and enhancement of educational opportunities for Native students. One important project funded by the Johnson O'Malley Committee is the construction of a small-scale fish hatchery on Humboldt Creek. This aquaculture program is integrated into the vocational education program of the school district. A pre-school program is also run with Johnson O'Malley funds. Summer recreation, Campfire, and arts are among programs provided by the Indian Education Committee.

## **Health and Social Services**

The operation of the City Health Clinic is overseen by the Health Board whose members are locally elected. A physician's assistant and medical receptionist are employed by the clinic. A health aide and alternate are employed by Aleutian-Pribilof Islands Association (A/PIA) and work out of the clinic. In 1982, a medical clinic with X-ray equipment, a laboratory, and a pharmacy partly funded by the State of Alaska was built. The clinic receives subsidies from both the City and the Alaska Native Medical Center in Anchorage. Services are offered on a fee basis and include immunizations, well baby clinics, emergency services, minor X-rays, temporary hospitalization, drug and alcohol counseling, and personal counseling.

Emergency Medical Services (EMS) have been provided in Sand Point since the winter of 1981. There are eight active EMTs, one of whom is a certified instructor. The EMS program is operated on a voluntary basis with public donations and State grants obtained by A/PIA, which also provides technical assistance and training.

## **Transportation**

Nearly all passengers and some freight are transported to Sand Point via air. The city has a state-owned airport with a 3,800-foot gravel runway which has recently been resurfaced. Currently, the only scheduled carrier is Reeve Aleutian Airways which utilizes turbo-prop aircraft. Two air taxi services also operate from Sand Point and the airport serves non-scheduled aircraft traffic. A plan has been proposed to realign the runway so that it can be lengthened to accommodate jet service.

Sand Point has a modern small boat harbor at the mouth of Humboldt Slough. The harbor was constructed by the Corps of Engineers in 1977 and encompasses 16 acres. In 1979, a harbor master station was added and, in 1981, a marine hoist and dock were completed. The current capacity of the boat harbor is 142 vessels. Development of a second boat harbor to provide additional moorage is being studied. Presently, bulk fuel for the fishing fleet is available from Aleutian Cold Storage.

The state ferry *Tustumena* operates from Seward to Sand Point four times a year carrying freight and passengers. In addition, vessels from Standard Oil Company, Sea Land, and Western Pioneer Company transport freight to the community. Presently, freight is delivered to the Aleutian Cold Storage dock until the City dock is fully operational.

The main road in Sand Point is an unpaved state road which links the airport with the City, a distance of approximately three miles. This road was rebuilt in 1982 with funds provided by the state. There are also a number of unpaved local residential streets and boardwalks. Vehicle traffic is comprised of automobiles, trucks, motorcycles, and "three-wheelers."

## **Electricity and Heat**

A central electrical source is maintained and operated by the seafood processor, Aleutian Cold Storage. Two diesel-fueled power plants with a total capacity of 3200 kilowatts are located in the community. Electricity is distributed by overhead and underground lines. A few residences and other operating seafood processors are not served by this system. In addition, a separate generation and distribution system serves the airport vicinity. Heat is obtained exclusively from fuel oil. Since January 1982, six windmills have been erected in Sand Point with a maximum combined capacity of 75 kilowatts.

## **Water**

The major water source for Sand Point is Humboldt Creek. Water is pumped from a reservoir behind a six-foot dam on the creek to a storage tank owned by the City of Sand Point. Before entering the tank, the water is chlorinated and fluoridated. The dam has recently been reconstructed. Prior to 1983, ten houses were served by a spring water source; the Peter Pan Seafoods facility has its own water supply. Major water system expansion and upgrading were undertaken in 1983 as well as exploration for future expansions.

## **Sewage and Solid Waste**

Sand Point has a sewage disposal system built by the U.S. Public Health Service in 1976 and the City plans future expansions. Sewage receives secondary treatment including aeration, clarification, and chlorination before being pumped through a 1,000-foot outfall to the ocean. With the exception of three or four houses, all the homes in Sand Point are connected to this sewage system. Fish waste from Aleutian Cold Storage is ground and pumped into the ocean at a depth of six fathoms.

The City has a 5.6 acre solid waste disposal site and a single point collection service.

## **Communications**

Interior Telephone, Inc. has operated a community-wide telephone system since 1971. The system was originally built by Wakefield Fisheries (now Aleutian Cold Storage) in 1969 and is connected by microwave to towers at Port Moller. An earth station is maintained in Sand Point by Alascom. This satellite system provides the community with television and improved telephone communications.

Public radio station KSDP-Sand Point began broadcasting in March 1982. The station was built primarily with funds from the State although the Sand Point Women's Club and the Lion's Club donated money to purchase the generator. The station operates five days a week offering local programming and serves as a repeater station for KDLG in Dillingham.

# **COLD BAY**

## **Location**

The community of Cold Bay is located on the southern end of the Alaska Peninsula south of Izembek Lagoon and on the northwest side of Cold Bay. The community is shown on Map K.

## **Population**

228 (1980 U.S. Census)

## **Economy**

Unlike other Aleutians East CRSA communities, the Cold Bay economy is not based on the commercial fishing industry. Cold Bay became established around the Fort Randall airstrip built by the U.S. military in 1942. The airport has remained the focal point of the city's economy. Government agencies, both state and federal, are a large source of employment. Most of those who work for the government are employed by federal agencies. Other sources of local employment include Reeve Aleutian Airways, charter air services, Flying Tigers' bar/hotel/store complex, school, truck rental, utility companies, and a small fish processing operation. The Flying Tigers' lease expires in 1984 and there is some concern about the effect on the economy of Cold Bay.

The community's economy has a very different structure from the other cities in the Aleutians East CRSA due to its heavy dependence upon government

in the Aleutians East CRSA due to its heavy dependence upon government employment. Cold Bay has nearly no unemployment since most people reside in the community because of their jobs. Many government and airline employees are in Cold Bay for a certain length of time and are then transferred elsewhere, a situation which contributes to the transiency of its population.

## **Government**

Cold Bay was incorporated as a second-class city in January 1982. A city council (7 members) is elected and one member is appointed to serve as mayor.

The federal government maintains a Federal Aviation Administration (FAA) office, Post Office, National Weather Service Office, RCA contract employees, and U.S. Fish and Wildlife Service office in Cold Bay. The latter are engaged in administration of the Izembek National Wildlife Refuge and the Alaska Peninsula National Wildlife Refuge. A biological and oceanographic research station established at Grant Point Air Force site is jointly managed by the University of Alaska and the U.S. Fish and Wildlife Service and is operated on a periodic basis.

The State of Alaska through the Department of Transportation and Public Facilities (ADOT/PF) maintains the airport and provides law enforcement and fire protection. A volunteer fire chief supervises volunteer crews. The airport manager and security person have police powers as do the Alaska Department of Fish and Game personnel stationed at the hatchery on Russell Creek and U.S. Fish and Wildlife personnel. The Magistrate maintains an office in Cold Bay and serves other regional communities. The State Trooper from Sand Point also serves Cold Bay.

## **Land Ownership**

Most land in Cold Bay is owned by the federal and state governments. Some is owned by the King Cove Native Corporation. Very little private land exists in the immediate vicinity of Cold Bay. In 1979, however, land disposals by the Alaska Department of Natural Resources sold 117 acres of land in 43 parcels. The majority of land is owned by the U.S. Fish and Wildlife Service, ADOT/PF's Division of Aviation, and Federal Aviation Administration.

## **Education**

The Cold Bay school is part of the Aleutian Region School District which is administered from Anchorage. The school which was built in 1961 has four classrooms, a library, and utility rooms. A multi-purpose room and offices were added in 1983. Four teachers are employed, one of whom also serves as school administrator. A program of elementary (including kindergarten) through high school education is offered depending upon the student population and teachers' experience. School enrollment in September 1983 was 49.

## **Health Services**

Cold Bay has a health clinic which is expected to be completed in fall 1983. Some medical services are provided by professionals passing through Cold Bay; however, most persons fly to Anchorage for treatment. The Cold Bay City Council has appointed a health director to oversee health care in the community. Currently, the clinic is being used for emergency care by Emergency Medical Services.

## **Transportation**

Cold Bay is accessible only by boats and aircraft. The airstrip, built during World War II, has a 10,400-foot main runway and a 5,200-foot crosswind runway. It is in need of resurfacing to accommodate modern wide-body commercial aircraft. Cold Bay experiences high winds in fall and winter and frequent summer fog. Reeve Aleutian Airways has scheduled service into Cold Bay and there is one air charter service, Peninsula Airways. Most passengers and a large quantity of freight are transported to Cold Bay by Reeve Aleutian. Peninsula Airways takes freight and passengers from Cold Bay to other villages in the vicinity. Bi-weekly cargo flights are flown to Dutch Harbor and Cold Bay by Alaska International Air (AIA).

Shipping to Cold Bay occurs throughout the year although hazardous conditions frequently occur during the winter. Cold Bay is usually ice-free, but about every 15 to 20 years freeze up does occur. Carriers to Cold Bay include Foss Alaska Lines, Western Pioneer Lines, Alaska Cargo Lines, and Northland Services. Bulk fuel is brought in several times per year by Chevron's *Alaska Standard*, and four times a year the Alaska state ferry *Tustumena* delivers passengers and freight.

The State of Alaska constructed the existing dock in 1979, replacing an older military dock. The structure is a T-shaped steel and concrete pier with catwalks to two mooring dolphins.

The city has few paved streets and no sidewalks; only the main airport apron road and the road connecting the terminal to the weather station are paved. There are, however, numerous gravel roads in the Cold Bay area and in the Izembek Refuge. These roads are in varying states of repair. A variety of motor vehicles are operated by local residents.

## **Electricity and Heat**

Three generators owned and operated by Northern Power and Engineering Company supply electricity to Cold Bay. Total capacity of the generators is 2200 kilowatts which is more than adequate for current levels of utilization. In 1983, there were 40 meters. Heating is primarily from fuel oil. Tankage for fuel is maintained by ADOT/PF, Chevron, and the U.S. Air Force. A study performed for the Alaska Power Authority in 1982 recommended installation of a waste heat recovery system in Cold Bay, but this has not yet occurred.

## **Water**

The water system was installed in 1959 by FAA and continues to be owned and operated by that agency. Water for Cold Bay is obtained from two wells and is stored in four holding tanks. A total of 30,000 gallons is chlorinated, fluoridated, and used for domestic purposes while an additional 50,000 gallons in state-owned tanks is untreated and held in reserve for fire fighting. At present there are 65 residences connected to the system which is operating at capacity.

## **Sewage and Solid Waste**

The sewage system was built by FAA in 1968 and serves generally the same customers as the water system. Sewage is received into a lagoon, mechanically aerated, chlorinated, and pumped into Cold Bay through an outfall. The system often operates beyond its capacity but is usually adequate for Cold Bay's needs. The FAA collects solid waste three times per week from FAA housing and incinerates it.

customers as the water system. Sewage is received into a lagoon, mechanically aerated, chlorinated, and pumped into Cold Bay through an out-fall. The system often operates beyond its capacity but is usually adequate for Cold Bay's needs. The FAA collects solid waste three times per week from FAA housing and incinerates and buries it at a dump site. Other residents transport their own solid waste to the dump.

## **Communications**

The Interior Telephone Company provides telephone service to Cold Bay with Alascom providing long distance telephone via satellite relay. Radio communication is available through the U.S. Fish and Wildlife Service, ADF&G, FAA and some private operators. Satellite television is available to Cold Bay residents and the Dillingham radio station (KDLG) can be heard.

# **KING COVE**

## **Location**

King Cove is located on the south side of the Alaska Peninsula in King Cove which is directly north of Deer Island. The community is shown on Map K.

## **Population**

1983 King Cove City Census = 536 permanent residents, 1980 U.S. Census = 467 permanent residents, approximately 200 seasonal residents.

## **Economy**

King Cove's economy is dependent upon commercial fishing and seafood processing. The Peter Pan Seafoods cannery, originally built in 1911, burned in 1976 and was replaced in 1978. The modern facility which has both canning lines and freezers processes salmon, salmon roe, king and tanner crab, halibut, and herring from both Aleutians East CRSA and other waters. Salmon is the primary species harvested by local fishermen with king crab and tanner crab also being important. Small quantities of halibut and herring are also harvested. In 1980, 85 limited entry permits for salmon were held by King Cove residents. Many local fishermen have vessels equipped to participate in both the salmon and crab fisheries.

Other employment in the community derives from local businesses such as the cannery store, non-processing cannery workers, postmaster, airlines, general store, bars, taxi, and trucking company. Many persons in the community work at more than one part-time job. Subsistence is also an important part of the community's economy.

## **Government**

King Cove has been an incorporated first-class city since 1949. Local government consists of the mayor, city council, and planning commission. A city manager, city clerk, and assistant clerk are employed. The city manager is shared with Sand Point. Services provided by the city include electricity, water, sewer, landfill, police, and medical care.

The airport is owned and maintained by the State of Alaska. The federal government employs two post office personnel.

Law enforcement is provided by a policeman hired by the city; there is also a village protection safety officer. Fire protection is on a volunteer basis. A public safety building has recently been built on Heart Lake. The state trooper in Sand Point and the magistrate in Cold Bay serve King Cove.

### **Land Ownership**

The majority of land within King Cove is owned by the King Cove Native Corporation. Other land owners include Peter Pan Seafoods, the City of King Cove, and private individuals.

### **Education**

King Cove's present school was constructed in 1973 and was expanded in 1976. It offers instruction to an enrollment of 110 students (September 1983) from kindergarten through twelfth grade. The school employs a principal and 16 full-time and 2 part-time teachers and has a library, gymnasium, and shop. There are also several support personnel such as secretaries and custodians. The school is overseen by a locally elected school board.

### **Health Services**

A physician's assistant and licensed practical nurse provide health care for King Cove. There is also a health aide and a community health representative hired by Aleutian-Pribilof Islands Association. Facilities were previously located in a small house owned by the cannery; however, a new municipal health facility was built with state assistance in 1982. Emergency cases are usually transported by air charter, Reeve Aleutian Airways, or the Coast Guard to Anchorage. Twice a year, U.S. Public Health Service medical and dental personnel visit King Cove.

### **Transportation**

Access to King Cove is solely via air and sea and is highly dependent upon weather. The state owns a 4,300 foot gravel runway at King Cove. The only regularly scheduled flights are from Cold Bay by Reeve Aleutian and Peninsula Airways. There are air charter services from Sand Point and Cold Bay. All flights must occur in suitable weather and in daylight as there are no aids to navigation at King Cove.

Freight is transported to the community by sea. Western Pioneer, Chevron, and Sea Land ship cargo and fuel to King Cove on a semi-regular basis. The only large dock is owned by the cannery although plans are being made for construction of a public dock. The city owns a small boat harbor which accommodates approximately 85 boats year-round, 120 in the summer. The harbor was built by the Corps of Engineers in 1978. In 1979, harbor master facilities were built and two mooring floats for larger vessels were added. Also, a marine service wharfage with warehouses and bulk fuel storage has been built behind the harbor master facility. The ferry *Tustumena* visits King Cove four times per year.

Roads in King Cove are gravel. The main road is state owned and is, for the most part, very narrow and hard to maintain. A road improvement project was begun in 1983. Residents operate a variety of cars, trucks, and three-wheeled cycles. There is a part-time taxi service. Boardwalks connect portions of the town, particularly around the waterfront.

Three diesel generators supply power for the municipal electrical system. Electricity is supplied to all except two residents within the city limits. Peter Pan Seafoods, Inc. owns and maintains its own power source. Plans have been made for a hydroelectric power plant on Delta Creek but funding for the project has not yet been received.

## **Water**

Water for King Cove is obtained from an impoundment on Ram Creek. From the impoundment, water flows by gravity through buried pipes, to a water treatment building and then to the town. Some dwellings outside the city limits have their own water supplies. Dam modifications and water system extensions are planned for 1984.

## **Sewage and Solid Waste**

A sewer system was installed in King Cove in 1970 but has not worked consistently since. When the system malfunctions, untreated sewage bypasses the treatment tanks and discharges directly into the cove. Modifications are planned for 1984. Most residences in King Cove are dependent upon the system; approximately 10 percent utilize septic tanks. Ground-up seafood processing wastes are dumped by the cannery into the cove through an ocean outfall.

The city has a solid waste landfill near the small boat harbor; no collection service is provided.

## **Communications**

Telephone service is provided by Interior Telephone Company. This system is tied into Alascom's communication satellite which provides long-distance telephone capability and television reception. Radio reception is generally poor in the area although the Dillingham station can be heard. Reeve Aleutian Airways maintains a radio antenna in the city but the transmitter is inoperative. The King Cove Corporation established a cable television system in 1983.

# **FALSE PASS**

## **Location**

False Pass is located on the eastern side of Unimak Island on Isanotski Strait which separates the island from the Alaska Peninsula. Isanotski Strait is directly south of Bechevin Bay. The community is shown on Map K.

## **Population**

70 permanent residents (1980 U.S. Census), 120 seasonal residents.

## **Economy**

Seasonal salmon fishing is the mainstay of the False Pass economy. Most of the village men fish for salmon in the summer, and occasionally crew on a King Cove or Sand Point crab boat during the fall and winter. A cannery was built in False Pass in 1928 and the village grew up around it, primarily populated by persons who emigrated from the villages of Morzhovoi, Ikatan, and Sanak Island. Originally owned by P.E. Harris Company, the cannery was later bought by Peter Pan Seafoods and processed fish from the Port Moller/Nelson Lagoon area as well as False Pass. From 1973 to 1977 the cannery was closed. This caused economic hardship for the up to 20 villagers often employed by the cannery. In 1981 the cannery burned. A seasonal buying station and small maintenance and supply base continue to operate on the cannery site. There are no current plans to rebuild the cannery.

Other jobs available in the village include cannery caretaker and assistant, school teacher, janitor, store clerk, postmaster, health aide, community building maintenance worker, and community planning coordinator. Subsistence hunting and fishing is also very important to the local economy. The residents harvest a variety of resources for subsistence use including caribou, seal, geese, halibut, octopus, salmon, berries, and wild cattle from Sanak Island. Of these, caribou and salmon are the most important subsistence resources (Chapter 18).

## **Government**

False Pass is an unincorporated village within an unorganized borough. It is governed by a village council which meets on an irregular basis. The council receives some state and federal monies. A village planning coordinator has recently been hired. There are no state employees in the village and the only federal employees are the postmaster and a postal clerk. The state trooper in Sand Point and the magistrate in Cold Bay serve the village.

## **Land Ownership**

The majority of land in the vicinity of False Pass has been selected under ANCSA by the False Pass Corporation. There are only two areas with the related land that are privately owned; one is the cannery site. The state maintains that 1280 acres of this corporation land should be placed into townsite trusteeship until the village incorporates. The villagers, however, prefer to own their own house lots and have the rest in the corporation's ownership. The Aleutian Islands portion of the Alaska Maritime National Wildlife Refuge borders the village on the west.

## **Education**

There is a school at False Pass which contains one classroom and quarters for one full-time teacher. Two full-time teachers reside in Peter Pan Seafoods housing. The school facility is inadequate for the current enrollment of 26 students and there are plans for an addition when state funds are available. Education is provided for students from kindergarten through twelfth grade. The school is administered by the Aleutian Region School District, part of the regional education attendance area system. Local school matters are handled by a three-member local school committee.

Year-round health care is provided by a health aide trained under the U.S. Public Health Service Native Health Service Program and employed by the Aleutians-Pribilof Islands Association. Supervision and medical consultation are available via telephone to the Native Medical Center in Anchorage. Health care facilities are located in the community building. Additional medical and dental services are provided by Public Health Service personnel who visit the village several times a year.

### **Transportation**

False Pass is accessible only by sea and air. Reeve Aleutian Airways has a contract with Peninsula Airways to provide weekly flights from Cold Bay. Mail, passengers, and some freight arrive in the community by air. There is a 4,300-foot gravel airstrip at False Pass but it is unusable except by small planes since stream erosion bisected it in 1963. There are no aids to navigation at False Pass so flying is weather dependent. Fog is a problem in the summer and high winds are frequent in the fall and winter.

Western Pioneer Lines stops at False Pass about 16 times a year. Chevron brings fuel to the community. Some freight is delivered to King Cove and transported to False Pass via fishing boat when convenient. There is no small boat harbor at False Pass; fishing vessels tie up offshore. The only docks are owned by Peter Pan Seafoods.

There are few roads in False Pass. Vehicular traffic consists of some automobiles, trucks, and three-wheeled all-terrain vehicles. Boardwalks connect the various parts of the village.

### **Electricity and Heat**

In late 1983, construction began on a central power plant with two generators providing 200 kilowatts; funding was provided by the state. Until its completion, electricity is provided by individual generators. The cannery has two generators totalling 135 kilowatts, the school has its own generator and most homes have small diesel generators. Most homes are heated with fuel oil, usually burned in cook stoves.

### **Water**

The water system for the cannery also supplies the village. Water is obtained from an impoundment on a small stream north of the village and flows by gravity to the homes. Because water is plentiful and of relatively good quality, fishing boats often stop in False Pass to take on water.

### **Sewage and Solid Waste**

Most False Pass homes have septic systems installed in 1982. The cannery has a secondary treatment facility that discharges to Isanotski Strait through an outfall.

Solid waste is collected twice weekly and placed in a dump approximately one mile west of the village.

## **Communications**

False Pass has phones owned by the Sitka Telephone Company. Alascom provides long distance capability and television reception through their satellite communications system. The cannery has an SSB radio, and citizen's band (CB) radios are used by the villagers for local communications. The Dillingham radio station can be heard.

# **NELSON LAGOON**

## **Location**

The community of Nelson Lagoon is situated on the north side of the Alaska Peninsula on a sand spit which separates Nelson Lagoon from the Bering Sea. It is about 30 miles west of Port Moller. The community is shown on Map K.

## **Population**

59 permanent residents (1980 U.S. Census)

## **Economy**

The economy of Nelson Lagoon is dependent upon salmon fishing. This rich resource has produced a relatively high standard of living in the village. In 1980, there were 35 limited entry permits issued to 23 Nelson Lagoon residents. There is no processing plant in Nelson Lagoon and fish are either sold to the Peter Pan Seafoods cold storage facility at Port Moller or delivered to one of several floating processors or tenders anchored in the Nelson Lagoon/Port Moller area. The Port Moller Cold Storage employs up to 120 seasonal workers, most of whom are from Seattle. In 1981, only one Nelson Lagoon resident worked at the Cold Storage.

Other jobs in the village include those associated with the school and the Nelson Lagoon Village Corporation. A small fuel company is operated by the Nelson Lagoon Corporation. Subsistence is an important part of the economy; caribou, geese, ducks, and bear are hunted and wolverine, mink, and fox are trapped by the locals. Residents also fish for personal use. Some persons who commercially fish salmon during the summer supplement their incomes by operating boat storage areas, repairing electronic equipment, or doing carpentry work—all related to fishing needs. One fisherman operates a five-unit motel during the summer.

## **Government**

Nelson Lagoon is an unincorporated village within the unorganized borough. A five-member village council governs the village and is presided over by the chief/village president. The council receives some state and federal funds. There are no paid state or federal jobs in Nelson Lagoon. The Nelson Lagoon Village Council and Corporation jointly employ an electric plant manager, secretary/bookkeeper, janitor, and maintenance man for the water project. The state trooper in Sand Point and the magistrate in Cold Bay serve the village.

## **Land Ownership**

The unpatented lands in and around the village have been selected by the Nelson Lagoon Village Corporation. When conveyed, the lands will then be transferred to persons who have historically occupied them. Because the village is unincorporated, 1,280 acres will be held in trust by the state until a municipality is formed.

## **Education**

The original school was built in 1960 and a new school was built in 1980. Both elementary and secondary education are provided in the village. Three teachers instruct 18 to 20 students. The school is administered by the Aleutian Region School District. Local school matters are handled by a community school committee.

## **Health Services**

Currently, no medical care is available in Nelson Lagoon, except for medical and dental services provided by Public Health Service personnel who visit the village twice a year. The majority of residents travel to Anchorage for health care.

## **Transportation**

Nelson Lagoon can be reached only by sea or air. Until 1980, air access to the village was hampered by the fact that no adequate gravel airstrip existed. A 3,400-foot gravel strip was subsequently built by the state. Currently, air traffic consists of air charters (some amphibious) from communities with scheduled commercial air service. Weather determines the accessibility of Nelson Lagoon by air as there are no aids to navigation at the village. Fog and winds render flying impossible about 25 percent of the year.

Cargo is brought in by the *North Star* each spring and Sea Land occasionally stops at Port Moller during the fishing season. Fuel is delivered by Chevron's *Alaska Standard*. There is no dock or boat harbor at Nelson Lagoon. Boats must be stored onshore during the winter as the lagoon freezes over.

Nelson Lagoon has about three miles of road. There are some automobiles and trucks in the village but most ground transportation is dependent upon snowmobiles and three-wheeled vehicles. The freshwater site is accessed along a beach road.

## **Electricity and Heat**

In 1979 the State Division of Energy and Power Development installed generators capable of producing a total of 70 kilowatts to serve the school and all homes in Nelson Lagoon via an underground cable. In 1981 a wind power demonstration project was installed in the village by the Alaska Power Authority. This system was dismantled in 1982. Homes are heated primarily with oil furnaces.

## **Water**

An adequate source of drinking water is a problem for Nelson Lagoon. Wells in the vicinity of the village produce brackish water and are used only for washing clothes and flushing toilets. Drinking water was previously obtained either from rainwater catchments or from a freshwater lake located several miles from the village. In 1983, a new water system was constructed and includes 10 miles of pipe, a storage tank with a capacity of 600,000 gallons, and five fire hydrants.

## **Sewage and Solid Waste**

Nelson Lagoon does not have a community sewer system. All houses have flush toilets and seepage pits or septic tanks.

There is no solid waste collection system or landfill area. Solid waste is disposed of by dumping on the sea side of the spit or by incineration in barrels.

## **Communication**

Most villagers in Nelson Lagoon have telephones which have connections to the Alascom satellite communications system and are owned by Sitka Telephone Company. Citizen's band and VHF radios also provide communication within the village, to boats offshore, and to Port Moller. Satellite television via the Rural Alaska Television Network and radio from Dillingham is received in the community.

# **BELKOFSKI**

Belkofski is a very small settlement with few facilities or amenities. The village of Belkofski is located on the south side of the Alaska Peninsula east of Belkofski Bay approximately 12 miles east of King Cove. The community is shown on Map K. It is unincorporated and governed by a village council whose six members all reside in King Cove. Land within the village has been selected under ANCSA by the Belkofski Village Corporation and will be conveyed eventually to persons who have historically used or occupied them. The State will hold 1,280 acres of this land in trust until the village incorporates.

The village contains a large Russian Orthodox Church built in the 1800s when it served as the administration center for the Church in the Aleutians. Currently, efforts are being made to place the church on the register of historical sites.

Most residents of the village, which numbered 185 in 1890, moved to King Cove in 1976 when the school closed due to low enrollment. The remaining five adults and two children (unofficial count) all occupy one house. King Cove provides the nearest source of employment, goods, and health, education, and social services. No fishing permits are held in Belkofski. Subsistence hunting and fishing are important to the residents.

It is believed that the one house currently occupied in Belkofski has an electric generator. Gasoline, fuel oil, and kerosene are brought in barrels via small boat. In addition to fuel oil, driftwood is burned to obtain heat. Water is obtained from two small unnamed streams near the village. Solid waste and

waste from "honey buckets" used by the residents are dumped into the sea or onto the beach.

Access to the village is primarily by small boat. There is no airstrip or small boat harbor. The only means of communication is by citizen's band and VHF radio. The Rural Alaska Television Network and the Dillingham radio station may be received in Belkofski.

---

## **CHAPTER 17**

# **Land Ownership and Management**

---

### **INTRODUCTION**

Land ownership in the Aleutians East CRSA is complex. Title to some acreage has not been transferred from the Bureau of Land Management (BLM) to the State or private owners. Beyond the checkerboard land ownership patterns, Native corporations have overselected land within the National Wildlife Refuges. The State has also selected land within the refuges. Future resolution of land status will depend on potential resource development and land values as well as BLM adjudication and validity of the selections of state lands, making it difficult to predict what specific changes may occur.

The land status information provided herein is generalized and is current as of September 1983. Table 17-1 shows the approximate number of acres owned or selected by each of the major land owners in the region, Map L shows its location.

Land ownership patterns and land management responsibility within the Aleutians East CRSA have changed considerably since the early 1900's. Land status has been influenced by federal executive orders, the Statehood Act, the Alaska Native Claims Settlement Act, and the Alaska National Interest Lands Conservation Act which requires the formulation of a cooperative management plan for the Bristol Bay region. The major land owners in the Aleutians East CRSA with land management responsibility are:

- The Federal Government
  - U.S. Fish and Wildlife Service
- The State of Alaska
  - Department of Natural Resources
- Municipal Governments
- Private
  - Aleut Regional Corporation
  - Village Corporations
  - Individuals, Other

The federal government first laid claim to land in the Aleutians East CRSA with the purchase of Alaska in 1867. In 1913 President William H. Taft signed an Executive Order to set aside all islands of the Aleutian Chain, including Unimak and Sanak Islands, in a federal reservation called the Aleutian Island Reservation. The reservation was designated as a "preserve and breeding ground for native birds, propagation of reindeer and fur bearing animals, and for the encouragement and development of the fisheries." It was placed under what was then the Department of Agriculture and Department of Commerce and Labor. In 1960 Izembek Lagoon Reserve was established through an Executive Order in recognition of the rich waterfowl and wildlife habitat of the area. It was to be managed by the Secretary of Agriculture.

With Statehood in 1959 the State of Alaska was given the right to select 104 million acres within its boundaries. After conducting a series of projects to assess the resource potential of land on the Alaska Peninsula, the State made selections in 1968, 1977 and 1978. While there is no official record of the reasons why the State made its specific selections before 1978 on the Alaska Peninsula, it is believed that some of the acreage was selected for fish and wildlife habitat; other acreage along the north shore of the Alaska Peninsula was selected for its oil and gas potential; while other selections were to reserve potential transportation corridors from the north to the south side of the Peninsula.

The State of Alaska also owns and manages the nearshore waters surrounding the Aleutians East CRSA from mean high water to three miles offshore, including bays, lagoons, and estuaries. State jurisdiction includes tide and submerged lands in the Izembek National Wildlife Refuge. The Alaska Legislature established the Izembek State Game Refuge in 1972 in order to protect the natural habitat and wildlife populations with particular emphasis on the waterfowl resources. The 1972 legislation also established a State Critical Habitat Area at Port Moller.

The passage of the Alaska Native Claims Settlement Act (ANCSA) in 1971 began a period of change in land ownership throughout Alaska. ANCSA mandated the creation of Regional and Village Native Corporations in Alaska which were entitled to receive land. The Aleut Regional Corporation and thirteen village corporations were established in the Aleutians. To date the Aleut Regional Corporation and seven village corporations have received land within the Aleutians East Region. ANCSA also provided for several of the Aleut village corporations from outside the Aleutians East CRSA to select from federal lands in the region. The acreage selected and conveyed to village corporations from both within and outside the Region is shown in Table 17-2. The Act provided village corporations with the surface estate and the Aleut Corporation with the subsurface estate. The Aleut Corporation has the ability to receive subsurface and/or surface estate through overselections relating to ANCSA 14 (h) (8) and 12 (a) and (b).

With the passage of the Alaska National Interest Lands Conservation Act (ANILCA) in December 1980, the U.S. Congress redesignated the Aleutian Island Reserve to the Alaska Maritime National Wildlife Refuge and the Izembek Range to the Izembek National Wildlife Refuge. The Act also created the 3.5 million acre Alaska Peninsula National Wildlife Refuge along the Pacific coast side of the Peninsula from Becharof National Wildlife Refuge to False Pass. Over one-third of this refuge is in the Aleutians East CRSA. Congress mandated that a comprehensive and systematic cooperative management plan be prepared and implemented by December 1983 for the Aleutians East-Bristol Bay Region. The purpose of the Bristol Bay Cooperative Management Plan (BBCMP) is to:

- 1) conserve the fish and wildlife, and other significant natural and cultural resources within the region;
- 2) provide for the rational and orderly development of economic resources within the region in an environmentally sound manner;
- 3) provide for exchanges of land between the major land owners in the region;
- 4) provide for identification of lands appropriate for state selection; and
- 5) identify any further lands in the region which may be appropriate for Congressional designation as national conservation system units.

As of this writing the Bristol Bay Cooperative Management Plan is nearing completion but has yet to be adopted. The plan provides Federal and State land managers in the region with guidance on how to manage lands under their jurisdiction. The plan contains policies that direct primary and secondary uses of land, including use of allocations for renewable and non-renewable resources. The plan also sets forth guidelines for development.

Other potential or existing land owners in the region include the Cities of Sand Point, King Cove, and Cold Bay, and the Villages of False Pass and Nelson Lagoon.

## **FEDERAL LAND**

Federal land in the Aleutians East Region is predominantly managed by the U.S. Department of Interior, Fish and Wildlife Service. The Alaska Maritime, Alaska Peninsula and Izembek Refuges are managed by the Secretary of the Interior for their fish and wildlife values.

The Secretary of Interior is required to develop a plan for each refuge which designates areas and compatible uses, and specifies programs for conserving fish and wildlife. Refuge plans are scheduled for completion in Fall, 1984. Commercial fishing and subsistence use by local residents is allowed in refuges. Exploration and development of oil and gas resources, where compatible with other existing resources, is also allowed.

The Bristol Bay Cooperative Management Plan recommends reorganizing the National Wildlife Refuges on the Alaska Peninsula to provide efficient and effective management of fish and wildlife resources. Specific recommendations include reallocating the refuge lands in the Becharof (outside the region), Izembek and Alaska Peninsula Refuges into two refuges, with the new refuge boundary crossing the Peninsula at Right Head Bay off Port Moller. All of Izembek National Wildlife Refuge and the southern unit of the Alaska Peninsula National Wildlife Refuge (Pavlov Unit) would be consolidated into the Izembek National Wildlife Refuge. These recommendations would facilitate administration of the refuges and would not alter acreage or change management intent for the affected areas.

Congress has also designated certain Wildlife Refuge lands in Izembek and Alaska Maritime National Wildlife Refuges as National Wilderness Areas. Three hundred thousand acres of Izembek National Wildlife Refuge are wilderness, as is Simenof Island and most of Unimak Island which are both in the Alaska Maritime National Wildlife Refuge.

## STATE LAND

The State lands in the region are managed by the Department of Natural Resources which is directed by statute to manage land for multiple use including fish and wildlife habitat, oil and gas exploration and development, minerals management, forestry, agriculture, recreation and land disposals. The State is required to produce area plans for all State land in Alaska. State agencies have been actively involved in the Bristol Bay Cooperative Management Plan. The BBCMP will be the area plan for State land in the region. The recommended plan specifies that State land in the Aleutians East Region be managed, where appropriate, for fish and wildlife habitat and harvest, oil and gas exploration and development, mineral exploration and development, transportation related to oil, gas or mineral activities, and settlement.

The BBCMP also recommends settlement of some disputed state land selections in the Alaska Peninsula and Alaska Maritime National Wildlife Refuges known as 11 (a) lands. State selections around Port Moller and Stepovak may be transferred from the Bureau of Land Management to the State, and the 11 (a) 3 lands east of Bear Lake would be relinquished and become part of Alaska Peninsula National Wildlife Refuge. Selections on Nagai Island would also be relinquished by the State and become part of the Alaska Maritime National Wildlife Refuge.

The recommended plan also provides that the State tidelands and submerged lands along the north shore of the Aleutians East Region will not be leased for oil and gas until 1994. Herendeen Bay, Nelson Lagoon, Port Moller, Moffet Lagoon, and Bechevin Bay are not to be placed on the State 5-year oil and gas lease sale schedule. The draft plan is scheduled for signature by the Alaska Land Use Council, Governor, and Secretary of Interior in Spring, 1984.

## PRIVATE LAND

The major private land owners in the region are the Aleut Regional Corporation and village corporations established through the Alaska Native Claims Settlement Act.

ANCSA provided that the Aleut Regional Corporation receive the subsurface estate of village corporation land. The Aleut Corporation is entitled to 1,450,763 12 (a) village (including 142,415 in lieu acres) subsurface acres. The breakdown is as follows:

12 (a) lands	1,221,120
12 (b) lands	142,532
14 (h) (8) lands	142,532
14 (h), (1, 2 & 5) lands	33,728
	<hr/>
	1,538,912

Approximately 467,120 acres of this acreage is in the Aleutians East Region 42 percent of their total entitlement. It should be noted that land status is very fluid and is changing all the time.

The Aleut Corporation has overselected considerable acreage and is in the process of identifying the Corporation's interest in lands with the highest economic potential. The Corporation is also entitled to 8,160 acres of land within some combination of refuges in the Aleut Region in exchange for conveying the same amount in subsurface acreage on the Pribilof Islands underlying surface interests now or soon to be owned by the U.S. Fish and Wildlife Service.

The Aleut corporation will own the subsurface estate to various U.S. Fish and Wildlife Service lands in the Aleutians East Region. This is the result of "in-lieu" selections made by False Pass and Atxam Corporations within the National Wildlife Refuges. These corporations were given authority to select lands where the Aleut Corporation did not receive the subsurface estate. The Aleut Corporation had the right to select other lands outside the refuge.

Pursuant to ANCSA, seven Village Corporations were organized in the Aleutians East Region. The Corporations and their land entitlements are listed in Table 17-2. The Corporations received 90% of their entitlement in 1979; transfer of title for additional acreage has yet to occur.

Three village corporations from outside of the Aleutians East region but within the Aleut Corporation Region—Atxam Corporation, St. George Tanaq Corporation and Tanadqusix Corporation—also own land in the Aleutians East CRSA (Table 17-2). These three village corporations selected land on the Alaska Peninsula because their acreage entitlement exceeded available acreage adjacent to their respective communities. Most of these selections are concentrated around Pavlof Bay and at the head of Balboa Bay.

Under ANCSA, as amended by ANILCA, all the Corporations are required to convey up to 1,280 acres of land to the local municipality or village council for use by the public. Shumagin and King Cove Corporations have completed this transfer and Nelson Lagoon and False Pass are currently negotiating regarding which lands to transfer.

Other than traditional uses, activity on village corporation lands outside municipal or village boundaries has been minimal.

## **LANDS ADJACENT TO VILLAGES AND COMMUNITY LANDS**

### **King Cove**

The King Cove townsite is 40.24 acres. The Peter Pan Seafoods cannery owns 27 of the 55 acres of the spit. King Cove Corporation selected all unpatented land in the township in which the city is located. Negotiations on the ANCSA 14 (c) 3 land transfers from the Village Corporation to the Municipality were completed in 1980. The Municipality received the roads leading into and outside the city, 9 acres of land adjacent to the power plant, and a parcel of land in the new Ram Creek Subdivision. The Army Corps of Engineers owns the breakwaters protecting the harbor and the State of Alaska owns the slips. The City has an active Planning Commission and has prepared a Comprehensive Plan for land use. The plan identifies guidelines for use of City land as well as future community uses and needs.

## **Cold Bay**

There is very little private land in Cold Bay. Most land is under State ownership and managed by the State Department of Transportation and Public Facilities, Division of Aviation. Some state and federal lands in the community are leased for housing. The federal government owns a large tract on which the Chevron Oil Co. tank farm is located, and the U.S. Fish and Wildlife Service has title to approximately 20 to 30 acres bordering the northeast edge of the developed area.

Three miles north of Cold Bay is a privately owned homestead site of approximately 100 acres. A smaller homestead plot is also located southeast of town. All other land in the Cold Bay vicinity is within the Izembek or Alaska Peninsula National Wildlife Refuge.

Cold Bay residents have been actively pursuing the availability of State land for public land disposal. The BBCMP recommends a 1000 acre disposal of lands in Cold Bay. This would include state acquisition of these lands from the U.S. Fish and Wildlife Service through a land exchange. The Fish and Wildlife Service would like to relinquish some land close to Cold Bay in exchange for other land adjacent to the Izembek or Alaska Peninsula National Wildlife Refuges which may be more suitable for inclusion in the refuge. The Aleut Corporation has also been discussing possible land exchanges around Cold Bay with the U.S. Fish and Wildlife Service.

## **Nelson Lagoon**

Pursuant to ANCSA, the Nelson Lagoon Village Corporation has received title to 63,462 (5,658 remaining) acres including all unpatented land in the township in which the village is located. The Corporation is working on reconveying title to the surface estate to third parties which have historically used or now occupy their lands.

As mandated in ANCSA, title of up to 1280 acres of lands will be transferred to the municipality. Nelson Lagoon has a Traditional Village Council and is not organized as a municipality. Therefore, the lands reconveyed to the village will be held in trust by the Municipal Lands Trustee, Alaska Department of Community and Regional Affairs. As of this writing Nelson Lagoon Village Corporation is expected to reconvey 14 (c) 3 lands in early 1985.

## **False Pass**

Pursuant to ANCSA, the False Pass Village Corporation has received title to 67,350 (1,770 remaining) acres including all unpatented land in the township in which the village is located. The Corporation is working on reconveying title to the surface estate to third parties which have historically used or now occupy their lands.

As mandated in ANCSA, title of up to 1280 acres will be transferred to the local municipality. False Pass has a Traditional Village Council and is not organized as a municipality. Therefore, the lands reconveyed to the village will be held in trust by the Municipal Lands Trustee, Alaska Department of Community and Regional Affairs.

As of this writing False Pass Village Council and Corporation are negotiating the 14 (c) 3 land reconveyances. False Pass has plans for a number of community projects within and in areas southwest of town which will require land for development. The reconveyance negotiations are expected to be com-

**Surface Estate**

State owned lands (not including tidelands)	~755,196
State owned lands including tidelands	~1,260,531
Village Corporation patented or interim conveyed	~611,307
Federal lands (mostly refuge lands)	~12,541,759
Federal lands	
State Selected	~523,404
Regional Corporation selected	~33,647
Village Corporation selected	~201,884
State, Regional, and Village selected	~17,446
State and Regional selected	~13,085
State and Village selected	~28,039

**Subsurface Estate**

Aleut Regional Corporation subsurface estate of patented or interim conveyed lands	611,500 <sup>1</sup>
--	----------------------

<sup>1</sup>This is only approximate. The Aleut Corporation's over-selections [in-lieu 12 (a), 12 (b), 14 (h) (8)] are still outstanding.

Source: Department of Natural Resources

**Table 17-2: Village corporation lands within the Aleutians East CRSA**

Village Corporation	Entitlement Acres	Conveyed Acres	Remaining Acres
Belkofski Corp.	69,120	66,861	2,259
False Pass Corp.	69,120	67,350	1,770
King Cove Corp.	115,200	109,116	6,084
Nelson Lagoon Corp.	69,120	63,462	5,658
Sanak Corp.	69,120	65,696	3,424
Shumagin Corp.	138,240	130,365	7,875
Unga Corp.	69,120	61,737	7,383
Total	539,040	564,587 <sup>1</sup>	34,453

Village Corporations outside Aleutians East CRSA	Total entitlement within and outside Aleutians East CRSA	Entitlement acres in Aleutians East CRSA
Atxam Corp. Selection	92,160	~ 21,120
St. George Tanaq Corp.	115,200	~ 12,800
Tanadqusix Corp. Selection	138,240	~ 12,800
Total	345,600	46,720

<sup>1</sup>Includes some land in Wildlife Refuges.

Source: The Aleut Regional Corporation, Fall, 1983; Aleutians East CRSA staff

---

## **CHAPTER 18**

# **Recreation, Sport Hunting and Fishing, and Subsistence Harvest of Fish and Wildlife**

---

### **INTRODUCTION**

The fish and wildlife of the Aleutians East CRSA represent a significant resource to area residents and to the state. Residents harvest these resources for subsistence use and sport hunters and fishermen avail themselves of the brown bear, waterfowl, caribou, and salmon found in the largely uninhabited region. The richness of its wildlife and its scenic beauty makes the Aleutians East CRSA a delight to hikers, birdwatchers, and photographers.

It is not easy, however, to clearly separate recreational, sport, and subsistence uses of fish and wildlife from one another; uses often overlap. In order to simplify this discussion, the terms will be separated in the following way: local residents who harvest fish and game for their own use as opposed to commercial sale will be considered to be engaged in *subsistence*; harvest by non-local persons, especially those who hire guides, will be considered *sport harvest*; and non-consumptive use of fish, wildlife, and habitat, i.e., hiking, photography, bird watching, etc. will be considered *recreational use*. Major use areas for these activities are shown on Map M.

### **SUBSISTENCE**

Subsistence is an important part of the lifestyle of most Aleutians East CRSA residents, although communities vary in their reliance upon it. The activities associated with food gathering provide an opportunity for families and communities to work together in a traditional manner and help to renew and strengthen social and cultural ties. Caribou, salmon, and berries constitute the majority of subsistence food gathered by residents of the various communities.

Although Sand Point has a viable cash economy, subsistence harvest of fish and wildlife is still an important facet of the economy. The primary species harvested are caribou and salmon. Residents hunt caribou on the Alaska Peninsula in the fall and winter. Families consume one to four caribou a year depending upon their reliance on subsistence food. Salmon are taken incidental to the commercial catch and are generally frozen although some are preserved in other ways such as smoking or drying. Annual estimates of subsistence salmon consumption range from 50 to 200 fish per family. Ducks and geese are also harvested. Hunting occurs at Left Hand Bay on Unga Island and as far away as Izembek Lagoon and Nelson Lagoon. Other foods gathered by Sand Point residents include crab, seagull eggs, shellfish, berries, and beach celery. Marine mammals are not harvested by Sand Point residents (Langdon 1982, BBCMP 1983)

Little information regarding subsistence activities is available for Cold Bay. This community largely operates on a cash economy; however, there is some harvesting of fish and

harvesting of fish and game for consumption by local families. In cash-based communities, the boundaries between subsistence and sport hunting are often unclear. Statistics from the Alaska Department of Fish and Game reveal that, in 1982, 21 subsistence fishing permits were held by Cold Bay residents. The Cold Bay permit holders harvested 535 red salmon, 95 cohos, 10 pink salmon, and 15 chum salmon from Mortensen Lagoon (BBCMP 1983, Langdon 1982).

Subsistence food gathering is more important to King Cove. Caribou are hunted in September along Cold Bay, in the area north of King Cove, and around Pavlof Bay. Most families consume four caribou a year. Salmon is also a very important staple. Silver salmon is the primary species taken; harvest occurs in August and early September. King salmon and red salmon are also taken to a certain extent earlier in the season, usually incidental to commercial harvests. Salmon is generally frozen or smoked. Other marine species consumed include king and tanner crab, halibut, cod, clams, and octopus. Ducks and geese are hunted in October and favored hunting spots include Morzhovoi Bay and areas in upper Cold Bay. Some residents, particularly those who moved to King Cove from Belkofski, harvest marine mammals, usually seals to make seal oil. King Cove people also utilize beach celery and various berries including salmonberries, mossberries, and wineberries (Langdon 1982, BBCMP 1983).

False Pass relies heavily on subsistence foods, particularly caribou and salmon. Caribou hunting occurs on Unimak Island in the area between Swanson's Lagoon and Urilia Bay. Most families use six to ten caribou per year. Red and silver salmon are harvested by the residents and frozen (in the case of reds) or smoked, salted, or dried (in the case of silver salmon). Silvers are harvested in Urilia Bay or near Thin Point. Most households consume 150 to 200 salmon per year. Some chum and pink salmon are also taken, as are halibut, cod, clams, and octopus. Ducks and geese are taken in Morzhovoi Bay and many residents harvest seals for seal oil. Berries which are picked by False Pass residents include mossberries, cranberries, blueberries, and salmonberries. These are frozen or made into jam (Langdon 1982, BBCMP 1983).

Residents of Nelson Lagoon travel to parts of the Alaska Peninsula to hunt and fish; the Hoodoo River and Herendeen Bay are two popular areas. Households consume two to four caribou each per year. Caribou are taken in the Herendeen Bay area. Salmon are usually preserved by smoking; red salmon and silver salmon are the species most often taken. Crab, halibut, and clams are consumed as are ducks and geese which are hunted in the fall in the Hoodoo River area. Residents must also travel to Herendeen Bay or the Hoodoo River to gather berries. Salmonberries, blueberries, and mossberries are most commonly harvested (Langdon 1982, BBCMP 1983).

---

# REFERENCES BY CHAPTER

---

## Chapter 1

- Alaska Coastal Management Program (ACMP). 1979. Standards and guidelines (6 AAC 80.900): definitions of coastal habitats.
- Alaska Department of Fish and Game (ADF&G). 1983(a). Resource report for sale no. 92, North Aleutian Basin. Marine/Coastal Habitat Management, Anchorage, Ak.
- \_\_\_\_\_. 1983(b). Preliminary determination of ACMP coastal habitats in the Aleutians East CRSA. Habitat Div., Marine/Coastal Habitat Management. Letter dated 10/13/83 from R. Sinnott, ADF&G, to J. Glaspell, Resource Analysts, and draft maps. Anchorage, Ak.
- Arctic Environmental Information and Data Center (AEIDC). 1976. Alaska regional profiles: south-west region. Report for the Office of the Governor, Juneau, Ak.
- Bailey, E.P. 1978. Breeding bird distribution and abundance in the Shumagin Islands, Alaska. *Murrelet* 59:82-91.
- \_\_\_\_\_. and N.H. Faust. 1980. Summer distribution and abundance of marine birds and mammals in the Sandman Reefs, Alaska. *Murrelet* 61:6-19.
- Bakkala, R.G. 1981. Population characteristics and ecology of yellowfin sole. In: D.W. Hood and J.A. Calder (eds.) *The Eastern Bering Sea: Oceanography and Resources*, Vol. 1. U.S. Dept. Commerce, National Oceanic and Atmospheric Administration, Office of Marine Pollution Assessment. Seattle, Washington: Univ. of Washington Press.
- Batten, A.R. and D.F. Murray. 1982. A literature survey on the wetland vegetation of Alaska. U.S. Army Corps of Engineers, Wetlands Research Program Technical Report Y-82-2. Vicksburg, Ms.
- Bristol Bay Cooperative Management Plan (BBCMP). 1983. Public review draft, Bristol Bay cooperative management plan and draft environmental impact statement (including appendices). State of Alaska—U.S. Department of Interior. Prepared under the direction of the Bristol Bay Study Group, June 1983. Anchorage, Ak.
- Brower, W.A., H.W. Searby, and J.L. Wise. 1977. *Climatic Atlas of the Outer Continental Shelf Waters and Coastal Regions of Alaska*. Vols. I and II: Gulf of Alaska and Bering Sea. Arctic Environmental Information and Data Center, Anchorage, Ak.
- Dunlop, H.A., F.H. Bell, R.J. Myhre, W.H. Hardman, and G.M. Southward. 1964. Investigation, utilization, and regulation of halibut in the southeastern Bering Sea. International Pacific Halibut Commission Report No. 35.
- Environmental System Research Institute. 1983. Bristol Bay mapping program. GSC-441, Final Report. Prepared for Bristol Bay Cooperative Management Plan, Alaska Land Use Council.
- Gill, R.E., M.R. Petersen, and P.D. Jorgensen. 1981. Birds of the northcentral Alaska Peninsula 1976-1980. *Arctic* 34(4):286-306.
- Gusey, W.F. 1979. *The Fish and Wildlife Resources of the Southern Bering Sea Region*. Shell Oil Company, Environmental Affairs. Houston, Texas.
- Hartman, W.H. and P.R. Johnson. 1978. *Environmental Atlas of Alaska*. Univ. of Alaska. Fairbanks, Ak.
- Hayes, M.O., E.R. Gundlach, and G.D. Getter. 1980. Sensitivity ranking of energy port shorelines. In: *Proceedings of the Special Conference on Ports, 1980*. ASCE, May 1980. Norfolk, Va.
- Hood, D.W. and J.A. Calder (eds.). 1981. *The Eastern Bering Sea Shelf: Oceanography and Resources*. Vol. II. National Oceanic and Atmospheric Administration, Office of Marine Pollution Assessment. Seattle, Washington: Univ. of Washington Press.
- Huffman, R.T. and G.E. Tucker. 1981. Preliminary guide to the onsite identification and delineation of the wetlands of Alaska (draft report). Technical Report EL-Y-81-9 prepared for the U.S. Army Engineer Waterways Experiment Station, Environmental Laboratory, Vicksburg, Ms.
- Hughes, R.C. 1973. Alaska coastal National Wildlife Refuges—final environmental impact statement. U.S. Department of the Interior, Washington, D.C.

- King, J.G., P.D. Christian, R.E. Gill, Jr., and L.M. Dresch. 1981. A quantitative catalogue of intertidal and nearshore bird habitats of the eastern Bering Sea. U.S. Fish and Wildlife Service, Juneau, Ak.
- Low, L.E., G.K. Tanonaka, and H.H. Shippen. 1976. Sablefish of the northeastern Pacific Ocean and Bering Sea. U.S. Dept. Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Processed Report.
- Major, R.L. and H.H. Shippen. 1970. Synopsis of biological data on Pacific Ocean perch, *Sebastes alutus*. National Marine Fisheries Service, FAO Species Synopsis No. 79, Circular 347. Washington, D.C.
- McCroy, C.P. 1968. The distribution and biogeography of *Zostera marina* (eelgrass) in Alaska. *Pac. Sci.* 22:507-513.
- Michel, J., D.D. Domericki, L.C. Thebeau, C.D. Getter, and M.O. Hayes. 1982. Sensitivity of coastal environments and wildlife to spilled oil in the Bristol Bay area of the Bering Sea, Alaska. Prepared by Research Planning Institute, Columbia, S.C., for National Oceanic and Atmospheric Administration, Outer Continental Shelf Environmental Assessment Program. Juneau, Ak.
- Morgan, L. (ed.). 1980. *The Aleutians*. Alaska Geographic, Vol. 7, No. 1. Anchorage, Ak.
- Morris, B.F., M.S. Alton, and H.W. Braham. 1983. Living marine resources of the Gulf of Alaska—a resource assessment for the Gulf of Alaska/Cook Inlet proposed oil and gas lease sale 88 (draft report). National Marine Fisheries Service, Anchorage, Ak.
- National Marine Fisheries Service (NMFS). 1980. Living marine resources and commercial fisheries relative to potential oil and gas development in the northern Aleutian Shelf area (tentative sale no. 75). Northwest and Alaska Fisheries Center, Seattle, Wa., and Auke Bay Lab., Auke Bay, Ak.
- Nysewander, D.R., D.J. Foresell, P.A. Baird, D.J. Shields, G.J. Weiler, and J.H. Kogan. 1982. Marine bird and mammal survey of the eastern Aleutian Islands, summers of 1980-81. U.S. Fish and Wildlife Service, Alaska Regional Office, Anchorage, Ak.
- Orth, D.J. 1967. *Dictionary of Alaska Place Names*. U.S. Geological Survey Professional Paper No. 567. Washington, D.C.: U.S. Gov. Printing Office.
- Ronholt, L.L., H.H. Shippen, and E.S. Brown. 1978. Demersal fish and shellfish resources of the Gulf of Alaska from Cape Spencer to Unimak Pass, 1948-1976: a historical review. National Oceanic and Atmospheric Administration, Northwest and Alaska Fisheries Center Processed Report, 4 vols. Seattle, Wa.
- Science Applications, Inc. 1981. North Aleutian shelf lease area. Unpublished report for U.S. Dept. Commerce, National Oceanic and Atmospheric Administration, and U.S. Dept. Interior, Bureau of Land Management. Boulder, Co.
- Schumacher, J.D. and P.D. Moen. 1983. Circulation and hydrography of Unimak Pass and the shelf water north of the Alaska Peninsula. National Oceanic and Atmospheric Administration Technical Memorandum ERL PMEL-47. Pacific Marine Environmental Laboratory. Seattle, Wa.
- Sears, H.S. and S.T. Zimmerman. 1977. Alaska intertidal survey atlas. U.S. Dept. Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northwest and Alaska Fisheries Center. Auke Bay, Ak.
- Thorsteinson, L.K. (ed.). 1984. The north Aleutian shelf environment and possible consequences of planned offshore oil and gas development (draft). Proceedings of a synthesis meeting, March 9-11, 1982, Anchorage, Ak. Outer Continental Shelf Environmental Assessment Program. Juneau, Ak.
- U.S. Department of the Interior (USDI), Minerals Management Service. 1982. Final environmental impact statement, proposed outer continental shelf oil and gas lease sale, St. George Basin. Anchorage, Ak.
- U.S. Geological Survey. Undated. Topographic maps (scale 1:250,000) of the Aleutians East Coastal Resource Service Area.
- Viereck, L.A. and E.L. Little, Jr. 1972. *Alaska Trees and Shrubs*. U.S. Dept. of Agriculture, Forest Service. Agriculture Handbook No. 410. Washington, D.C.
- Wahrhaftig, C. 1965. Physiographic divisions of Alaska. U.S. Geological Survey Professional Paper 482.

## Chapter 2

- Alaska Tsunami Warning Center. 1982. Distant source tsunami hazard in Alaska.
- Arctic Environmental Information and Data Center (AEIDC). 1976. Alaska regional profiles: southwest region. Report for the Office of the Governor, Juneau, Ak.
- Bristol Bay Cooperative Management Plan (BBCMP). 1983. Public review draft, Bristol Bay cooperative management plan and draft environmental impact statement (including appendices). State of Alaska—U.S. Department of Interior. Prepared under the direction of the Bristol Bay Study Group, June 1983. Anchorage, Ak.
- Bundtzen, T.K., G.R. Eakins, and C.N. Conwell. 1982. Review of Alaska's mineral resources. Alaska Dept. Natural Resources, Div. of Geological and Geophysical Surveys. Summary Report prepared for Alaska Dept. Commerce and Economic Development, Office of Mineral Development.
- City of Sand Point. 1981. City of Sand Point community comprehensive plan. Ordinance 81-4. January 1981.
- Davies, J.N. and K.H. Jacob. 1981. A seismotectonic analysis of the seismic and volcanic hazards in the Pribilof Islands—eastern Aleutian Islands region of the Bering Sea. Outer Continental Shelf Environmental Assessment Program. Juneau, Ak.
- Davies, J.N., L. Sykes, L. House, and K. Jacob. 1981. Shumagin seismic gap, Alaska Peninsula: history of great earthquakes, tectonic setting, and evidence for high seismic potential. *Journal of Geophysical Research*, Vol. 86, No. B5. Pp. 3821-3855.
- Lyle, W.M. and P.L. Dobey. 1974. Geologic evaluation of the Herendeen Bay area, Alaska Peninsula. Alaska Dept. Natural Resources, Div. of Geological and Geophysical Surveys. Open File Report #48. Anchorage, Ak.
- Motyka, R.J., M.A. Moorman, and S.A. Liss. 1981. Assessment of thermal spring sites: Aleutian Arc, Atka Island to Becharof Lake—preliminary results and evaluation Alaska Dept. Natural Resources, Div. Geological and Geophysical Surveys. Ak. Open-file Report 144. Anchorage, Ak.
- Pulpan, H. and J. Kienle. 1980. Seismic and volcanic risk studies, western Gulf of Alaska. Annual Report, Outer Continental Shelf Environmental Assessment Program. Geophysical Institute, Univ. of Alaska, Fairbanks, Ak.
- Science Applications, Inc. 1981. North Aleutian shelf lease area. Unpublished report for U.S. Dept. Commerce, National Oceanic and Atmospheric Administration, and U.S. Dept. Interior, Bureau of Land Management. Boulder, Co.

## Chapter 3

- Aksell, A. 1984. Personal Communication. Lands Dept., Aleut Corporation. Anchorage, Ak.
- Alaska Department of Natural Resources (ADNR). 1982. Mineral terranes map and Appendices B and C. Div. Land and Resource Planning, Anchorage, Alaska.
- \_\_\_\_\_. 1983. Oil and gas leasing handbook. Dept. Minerals and Energy Management, April 1983. Anchorage, Ak.
- Arctic Environmental Information and Data Center (AEIDC). 1976. Alaska regional profiles: southwest region. Report for the Office of the Governor, Juneau, Ak.
- \_\_\_\_\_. 1982. Mineral terranes of Alaska; 1982. Map series at scale 1:1,000,000, Plate D (Southcentral West). Univ. of Alaska, Anchorage, Ak.
- Berryhill, R.V. 1963. Reconnaissance of beach sands, Bristol Bay, Alaska. U.S. Dept. Interior, Bureau of Mines, Washington, D.C.
- Bristol Bay Cooperative Management Plan (BBCMP). 1983. Public review draft, Bristol Bay cooperative management plan and draft environmental impact statement (including appendices). State of Alaska—U.S. Department of Interior. Prepared under the direction of the Bristol Bay Study Group, June 1983. Anchorage, Ak.
- Bundtzen, T.K., G.R. Eakins, and C.N. Conwell. 1982. Review of Alaska is mineral resources. Alaska Dept. Natural Resources, Div. of Geological and Geophysical Surveys. Summary Report prepared for Alaska Dept. Commerce and Economic Development, Office of Mineral Development.
- Conwell, C.N. and D.M. Triplehorn. 1978. Herendeen Bay—Chignik coals, southern Alaska Peninsula. Alaska Dept. Natural Resources, Div. of Geological and Geophysical Surveys. Special Report 8, College, Ak.

- Eakins, G.R., T.K. Bundtzen, M.S. Robinson, J.G. Clough, C.B. Green, K.H. Clautice, and M.A. Albanese. 1983. Alaska's mineral industry, 1982. Alaska Div. of Geological and Geophysical Surveys Special Report 31, College, Ak.
- Kent, J.A. 1980. Apollo Consolidated Mining Company: a brief history of hardrock gold mining on Unga Island. Alaska Prospectors and Miners News. Pp. 26-27.
- Morgan, L. (ed.). 1980. *The Aleutians*. Alaska Geographic, Vol. 7, No. 1. Anchorage, Ak.
- Resource Associates of Alaska, Inc. 1984. The Alaska Peninsula. An example of an island arc mineralized terrane. Unpublished report to the Aleutians East CRSA. Fairbanks, Ak.
- Science Applications, Inc. 1981. North Aleutian shelf lease area. Unpublished report for U.S. Dept. Commerce, National Oceanic and Atmospheric Administration, and U.S. Dept. Interior, Bureau of Land Management. Boulder, Co.
- Walcott, C.D. 1896. Seventeenth annual report of the U.S. Geological Survey to the Secretary of the Interior, 1895-1896. Part I—Directors Report and Other Papers. Washington, D.C.

## Chapter 4

- Alaska Department of Fish and Game (ADF&G). 1977. A fish and wildlife resource inventory of the Alaska Peninsula, Aleutian Islands, and Bristol Bay areas. Vol. II—Fisheries. Report for the Alaska Coastal Management Program.
- \_\_\_\_\_. In Press. Southwest region regional guide. Groundfish life history map; groundfish human use map. Scale 1:1,000,000. Anchorage, Ak.
- Alton, M.S. 1981. Gulf of Alaska bottomfish and shellfish resources. National Oceanic and Atmospheric Administration, Technical Memorandum NMFS F/NWC-10. Seattle, Wa.
- Bakkala, R.G. 1981. Population characteristics and ecology of yellowfin sole. In: D.W. Hood and J.A. Calder (eds.) *The Eastern Bering Sea: Oceanography and Resources*, Vol. I. U.S. Dept. Commerce, National Oceanic and Atmospheric Administration, Office of Marine Pollution Assessment. Seattle, Washington: Univ. of Washington Press.
- \_\_\_\_\_. and T.M. Sample. 1982. Commercial fish resources of the southeastern Bering Sea (within proposed OCS sale 92, North Aleutian Basin). National Marine Fisheries Service. Northwest and Alaska Fisheries Center, Resource Assessment and Conservation Engineering Div. Seattle, Wa.
- \_\_\_\_\_. and L.L. Low. 1983. Condition of groundfish resources of the eastern Bering Sea and Aleutian Island region on 1982. National Oceanic and Atmospheric Administration, Technical Memorandum NMFS F/NWC-42.
- Bracken, B.E. 1982. Sablefish (*Anoplopoma fimbria*) migration in the Gulf of Alaska based on Gulf-wide tag recoveries, 1973-1981. Alaska Dept. Fish and Game Informational Leaflet 199. Juneau, Ak.
- Bristol Bay Cooperative Management Plan (BBCMP). 1983. Public review draft, Bristol Bay cooperative management plan and draft environmental impact statement (including appendices). State of Alaska—U.S. Department of Interior. Prepared under the direction of the Bristol Bay Study Group, June 1983. Anchorage, Ak.
- Curl, H.E. and C.A. Manen. 1982. Shellfish resources. In: H.J. Hameedi (ed.) *The St. George Basin Environment and Possible Consequences of Planned Offshore Oil and Gas Development*. U.S. Dept. Commerce, National Oceanic and Atmospheric Administration, Office of Marine Pollution Assessment. Outer Continental Shelf Environmental Assessment Program. Juneau, Ak.
- Donaldson, W.E., J.R. Hilsinger, and R.T. Cooney. 1980. Growth, age, and size at age of maturity of tanner crab (*Chionoectes bairdi*) in the northern Gulf of Alaska. Alaska Dept. Fish and Game Informational Leaflet No. 185. Juneau, Ak.
- Haflinger, K. 1981. A survey of benthic infaunal communities of the southeastern Bering Sea shelf. In: D.W. Hood and J.A. Calder (eds.) *The Eastern Bering Sea Shelf: Oceanography and Resources*. Vol. II. National Oceanic and Atmospheric Administration, Office of Marine Pollution Assessment. Seattle, Washington: University of Washington Press.
- Hilsinger, J. 1983. Personal communication. Fisheries biologist, Alaska Dept. Fish and Game, Kodiak, Ak.

- Jewett, S.C. and H.M. Feder. 1981. Epifaunal invertebrates of the continental shelf of the eastern Bering and Chukchi Seas. In: D.W. Hood and J.A. Calder (eds.) *The Eastern Bering Sea Shelf: Oceanography and Resources*. Vol. II. National Oceanic and Atmospheric Administration, Office of Marine Pollution Assessment. Seattle, Washington: Univ. of Washington Press.
- Major, R.L. and H.H. Shippen. 1970. Synopsis of biological data on Pacific Ocean perch, *Sebastes alutus*. National Marine Fisheries Service, FAO Species Synopsis No. 79, Circular 347. Washington, D.C.
- Malloy, L. 1983. Personal communication. Shellfish biologist, Alaska Dept. Fish and Game, Sand Point, Ak.
- Morris, B.F., M.S. Alton, and H.W. Braham. 1983. Living marine resources of the Gulf of Alaska—a resource assessment for the Gulf of Alaska/Cook Inlet proposed oil and gas lease sale 88 (draft report). National Marine Fisheries Service, Anchorage, Ak.
- North Pacific Fisheries Management Council (NPFMC). 1979. Fishery management plan for the groundfish fishery in the Bering Sea/Aleutian Island area. Anchorage, Ak.
- Otto, R.S. 1981. Eastern Bering Sea crab fisheries. In: D.W. Hood and J.A. Calder (eds.) *The Eastern Bering Sea Shelf: Oceanography and Resources*. Vol. II. National Oceanic and Atmospheric Administration, Office of Marine Pollution Assessment. Seattle, Washington: Univ. of Washington Press.
- \_\_\_\_\_, R.A. MacIntosh, K.L. Stahl-Johnson, and S.J. Wilson. 1983. Report to the industry on the 1983 eastern Bering Sea crab survey. National Marine Fisheries Service, Northwest and Alaska Fisheries Center Processed Report 83-18. Kodiak, Ak.
- Ronholt, L.L., H.H. Shippen, and E.S. Brown. 1978. Demersal fish and shellfish resources of the Gulf of Alaska from Cape Spencer to Unimak Pass, 1948-1976: a historical review. National Oceanic and Atmospheric Administration, Northwest and Alaska Fisheries Center Processed Report, 4 vols. Seattle, Wa.
- Sasaki, T. 1981. Changes in relative population numbers and size composition of sablefish in the Aleutian region and Gulf of Alaska, 1979 to 1981. Submitted to the North Pacific Fisheries Council by the Fisheries Agency of Japan, Tokyo, Japan.
- Science Applications, Inc. 1980. Environmental assessment of the Alaskan continental shelf. Kodiak interim synthesis report—1980. U.S. Dept. Commerce, National Oceanic and Atmospheric Administration, Office of Marine Pollution Assessment. Boulder, Co.
- \_\_\_\_\_. 1981. North Aleutian shelf lease area. Unpublished report for the U.S. Dept. Commerce, National Oceanic and Atmospheric Administration, and U.S. Dept. Interior, Bureau of Land Management. Boulder, Co.
- Shaul, A. 1983. Personal Communication. Alaska Dept. Fish and Game, Cold Bay, Ak.
- Smith, G.B. 1982. Commercial fish resources of the northwestern Gulf of Alaska (within proposed outer continental shelf sale 92, North Aleutian Basin)—with emphasis on sensitive areas and early life history stages. National Marine Fisheries Service, Northwest and Alaska Fisheries Center, Resource Assessment and Conservation Engineering Div. Seattle, Wa.
- \_\_\_\_\_, and R.G. Bakkala. 1982. Demersal fish resources of the eastern Bering Sea: spring 1976. National Oceanic and Atmospheric Administration Technical Report NMFS SSRF-754.
- Smith, R.L., A.C. Paulson, and J.R. Rose. 1978. Food and feeding relationships in the benthic and demersal fishes of the Gulf of Alaska and Bering Sea. Outer Continental Shelf Environmental Assessment Program, Final Report of Principal Investigators. Juneau, Ak.
- Thorsteinson, F.V. and L.K. Thorsteinson. 1984. Fishery resources. In: L.K. Thorsteinson (ed.) *The North Aleutian shelf environment and possible consequences of planned offshore oil and gas development* (draft). Proceedings of a synthesis meeting, March 9-11, 1982, Anchorage, Ak. Outer Continental Shelf Environmental Assessment Program. Juneau, Ak.

## Chapter 5

- Alaska Department of Fish and Game (ADF&G). 1977. A fish and wildlife resource inventory of the Alaska Peninsula, Aleutian Islands, and Bristol Bay areas. Vol. II—Fisheries. Report for the Alaska Coastal Management Program.
- \_\_\_\_\_. 1982. Alaska Peninsula/Aleutian Islands areas 1982 finfish annual report. Div. of Commercial Fisheries, Kodiak, Ak.

- \_\_\_\_\_. 1983. March 1983. Anchorage, Ak.
- Bristol Bay Cooperative Management Plan (BBCMP). 1983. Public review draft, Bristol Bay cooperative management plan and draft environmental impact statement (including appendices). State of Alaska—U.S. Department of Interior. Prepared under the direction of the Bristol Bay Study Group, June 1983. Anchorage, Ak.
- Carl, G.C., W.A. Clemens, and C.C. Lindsey. 1967. *The Freshwater Fishes of British Columbia*. Handbook No. 5, fourth edition. British Columbia Provincial Museum.
- Hart, T.L. 1973. *Pacific Fishes of Canada*. Fisheries Research Board of Canada Bulletin 180. Ottawa, Canada.
- Morrow, J.E. 1980. *The Freshwater Fishes of Alaska*. Anchorage, Alaska: Northwest Publishing Company.
- Robins, C.R., R.M. Bailey, C.E. Bond, J.R. Brooks, E.A. Lachner, R.N. Lea, and W.B. Scott. 1980. *A List of Common and Scientific Names of Fishes From the United States and Canada*. Fourth edition. American Fisheries Society Special Publication No. 12.
- Shaul, A. 1983. Personal communication. Fisheries biologist, Alaska Dept. Fish and Game, Cold Bay, Ak.
- Straty, R.R. 1981. Trans-shelf movements of Pacific salmon. In: D.W. Hood and J.A. Calder (eds.) *The Eastern Bering Sea Shelf: Oceanography and Resources*. Vol. II. National Oceanic and Atmospheric Administration, Office of Marine Pollution Assessment. Seattle, Washington: Univ. of Washington Press.
- Tack, S.L. 1970. The summer distribution and standing stock of the fishes of Izembek Lagoon, Alaska. M.S. Thesis, Univ. of Alaska, Fairbanks, Ak.
- U.S. Fish and Wildlife Service. (no date). Unimak Island wilderness study: Aleutian Islands National Wildlife Refuge, Third Judicial District, Alaska. U.S. Bureau of Sport Fisheries and Wildlife.

## Chapter 6

- Alaska Coastal Management Program. 1979. Resource report for sale no. 92, North Aleutian Basin. Alaska Dept. Fish and Game, Marine/Coastal Habitat Management, Anchorage, Ak.
- Alaska Department of Fish and Game (ADF&G). 1973. *Alaska's Wildlife and Habitat*. Map series. Juneau, Ak.
- \_\_\_\_\_. 1980. Marine resources of the North Aleutian Shelf proposed lease sale area (map). Scale 1:1,000,000.
- Bailey, E.P. and N.H. Faust. 1980. Summer distribution and abundance of marine birds and mammals in the Sandman Reefs, Alaska. *Murrelet* 61:6-19.
- Bristol Bay Cooperative Management Plan (BBCMP). 1983. Public review draft, Bristol Bay cooperative management plan and draft environmental impact statement (including appendices). State of Alaska—U.S. Department of Interior. Prepared under the direction of the Bristol Bay Study Group, June 1983. Anchorage, Ak.
- Calkins, D.G. and K.W. Pitcher. 1982. Population assessment, ecology, and trophic relationships of Steller sea lions in the Gulf of Alaska. Outer Continental Shelf Environmental Assessment Program. Juneau, Ak.
- Consiglieri, L.D. and H.W. Braham. 1982. Seasonal distribution and relative abundance of marine mammals in the Gulf of Alaska. Outer Continental Shelf Environmental Assessment Program. Juneau, Ak.
- Fay, F.H. 1981. Modern populations, migrations, demography, trophics and historical status of the Pacific walrus. Outer Continental Shelf Environmental Assessment Program. Juneau, Ak.
- \_\_\_\_\_. 1982. Ecology and biology of the Pacific walrus, *Odobenus rosmarus divergens* Illiger. U.S. Fish and Wildlife Service. North America Fauna No. 74. Washington, D.C.
- Frost, K.J., F.J. Lowry, and J.J. Burns. 1982. Distribution of marine mammals in the coastal zone of the Bering Sea during summer and autumn. Alaska Dept. Fish and Game, Fairbanks, Ak.

- Gill, R., P.D. Jorgensen, A.R. DeGange, and P. Kust, Sr. 1977. Avifaunal assessment of Nelson Lagoon, Port Moller and Herendeen Bay, Alaska. U.S. Fish and Wildlife Service, Office of Biological Services—Coastal Ecosystems. Anchorage, Ak.
- Gusey, W.F. 1978. *The Fish and Wildlife Resources of the Gulf of Alaska*. Shell Oil Company, Environmental Affairs. Houston, Tx.
- \_\_\_\_\_. 1979. *The Fish and Wildlife Resources of the Southern Bering Sea Region*. Shell Oil Company, Environmental Affairs. Houston, Tx.
- Hessing, P. 1981. Gray whale (*Eschrichtius robustus*) migration into the Bering Sea, spring 1981. Report prepared for National Oceanic and Atmospheric Administration, Office of Marine Pollution Assessment. Juneau, Ak.
- Morris, B.F., M.S. Alton, and H.W. Braham. 1983. Living marine resources of the Gulf of Alaska—a resource assessment for the Gulf of Alaska/Cook Inlet proposed oil and gas lease sale 88 (draft report). National Marine Fisheries Service, Anchorage, Ak.
- Nysegwander, D.R., D.J. Foresell, P.A. Baird, D.J. Shields, G.J. Weiler, and J.H. Kogan. 1982. Marine bird and mammal survey of the eastern Aleutian Islands, summers of 1980-81. U.S. Fish and Wildlife Service, Alaska Regional Office, Anchorage, Ak.
- Schneider, K.B. 1981. Distribution and abundance of sea otters in the eastern Bering Sea. In: D.W. Hood and J.A. Calder (eds.) *The Eastern Bering Sea Shelf: Oceanography and Resources*. Vol. II. National Oceanic and Atmospheric Administration, Office of Marine Pollution Assessment. Seattle, Washington: Univ. of Washington Press.
- Science Applications, Inc. 1981. North Aleutian shelf lease area. Unpublished report for U.S. Dept. Commerce, National Oceanic and Atmospheric Administration, and U.S. Dept. Interior, Bureau of Land Management. Boulder, Co.
- Thorsteinson, L.K. (ed.). 1984. The north Aleutian shelf environment and possible consequences of planned offshore oil and gas development (draft). Proceedings of a synthesis meeting, March 9-11, 1982, Anchorage, Ak. Outer Continental Shelf Environmental Assessment Program. Juneau, Ak.
- U.S. Department of the Interior (USDI), Minerals Management Service. 1982. Final environmental impact statement, proposed outer continental shelf oil and gas lease sale, St. George Basin. Anchorage, Ak.

## Chapter 7

- Alaska Department of Fish and Game (ADF&G). 1973. *Alaska's Wildlife and Habitat*. Map series. Juneau, Ak.
- Bailey, E.P. 1978. Breeding bird distribution and abundance in the Shumagin Islands, Alaska. *Murrelet* 59:82-91.
- \_\_\_\_\_. and N.H. Faust. 1980. Summer distribution and abundance of marine birds and mammals in the Sandman Reefs, Alaska. *Murrelet* 61:6-19.
- Bristol Bay Cooperative Management Plan (BBCMP). 1983. Public review draft, Bristol Bay cooperative management plan and draft environmental impact statement (including appendices). State of Alaska—U.S. Department of Interior. Prepared under the direction of the Bristol Bay Study Group, June 1983. Anchorage, Ak.
- \_\_\_\_\_. 1984. Agency review draft, Bristol Bay study group proposed cooperative management plan and final environmental impact statement. Vol. I. Bristol Bay Study Group—Alaska Land Use Council. Anchorage, Ak.
- City of Sand Point. 1981. City of Sand Point community comprehensive plan. Ordinance 81-4. January 1981.
- Gusey, W.F. 1979. *The Fish and Wildlife Resources of the Western Gulf of Alaska*. Shell Oil Company, Environmental Affairs. Houston, Tx.
- Science Applications, Inc. 1981. North Aleutian shelf lease area. Unpublished report for U.S. Dept. Commerce, National Oceanic and Atmospheric Administration, and U.S. Dept. Interior, Bureau of Land Management. Boulder, Co.

## Chapter 8

- American Ornithologists' Union. 1983. *Check-List of North American Birds*. Sixth Edition. Lawrence, Kansas: Allen Press, Inc.
- Arneson, P.D. 1980. Identification, documentation, and delineation of coastal migratory bird habitat in Alaska. Outer Continental Shelf Environmental Assessment Program. Juneau, Ak.
- Bailey, E.P. 1978. Breeding bird distribution and abundance in the Shumagin Islands, Alaska. *Murrelet* 59:82-91.
- \_\_\_\_\_ and N.H. Faust. 1980. Summer distribution and abundance of marine birds and mammals in the Sandman Reefs, Alaska. *Murrelet* 61:6-19.
- \_\_\_\_\_ and D.H. Davenport. 1972. Die-off of common murre on the Alaska Peninsula and Unimak Island. *Condor* 74(2):215-219.
- Bartonek, J.C. and C.J. Lensink. 1978. A review of the literature and selected bibliography of published and unpublished literature on marine birds of Alaska. Outer Continental Shelf Environmental Assessment Program. Juneau, Ak.
- \_\_\_\_\_ and D.D. Gibson. 1972. Summer distribution of pelagic birds in Bristol Bay, Alaska. *Condor* 74(2):416-422.
- \_\_\_\_\_ and D.N. Nettleship (eds.) 1979. *Conservation of Marine Birds of Northern North America*. Papers from International Symposium, May 13-15, 1975. U.S. Fish and Wildlife Service, Wildlife Research Report II, 1979.
- Bellrose, F.C. 1976. *Ducks, Geese, and Swans of North America*. Wildlife Management Institute. Harrisburg, Pennsylvania: Stackpole Books.
- Einarsen, A.S. 1965. *Black Brant: Sea Goose of the Pacific Coast*. Seattle, Washington: University of Washington Press.
- Gabrielson, I.N. and F.C. Lincoln. 1959. *The Birds of Alaska*. Stackpole Company and Wildlife Management Institute.
- Gill, R.E., M.R. Petersen, and P.D. Jorgensen. 1981. Birds of the northcentral Alaska Peninsula 1976-1980. *Arctic* 34(4):286-306.
- Gusey, W.F. 1979. *The Fish and Wildlife Resources of the Western Gulf of Alaska*. Shell Oil Company, Environmental Affairs. Houston, Tx.
- Guzman, J.R. and M.T. Myres. 1982. Ecology and behavior of southern hemisphere shearwaters (Genus *Puffinus*), when over the outer continental shelf of the Gulf of Alaska and Bering Sea during the northern summer (1975-1976). University of Calgary, Dept. of Biology. Calgary, Alberta, Canada.
- Handel, C.M., M.R. Petersen, R.E. Gill, Jr., and C.J. Lensink. 1981. *An Annotated Bibliography on Alaska Water Birds*. U.S. Fish and Wildlife Service, Coastal Ecosystems Project. USFWS/OBS-81/12.
- Hoffman, W. et al. 1981. The ecology of seabird feeding flocks in Alaska. *Auk* 98(3):437-456.
- Hood, D.W. and J.H. Calder (eds.) *The Eastern Bering Sea Shelf: Oceanography and Resources*. Vol. II. National Oceanic and Atmospheric Administration, Office of Marine Pollution Assessment. Seattle, Washington: Univ. of Washington Press.
- Hunt, G.J. Jr. et al. 1980. Reproductive ecology, foods and foraging areas of seabirds nesting on the Pribilof Islands, 1975-1979. Univ. of California, Irvine, Ca.
- \_\_\_\_\_, J. Kaiwi, and D. Schneider. 1982. Pelagic distribution of marine birds and analysis of encounter probability for the southeastern Bering Sea. Outer Continental Shelf Environmental Assessment Program. Final Reports of Principal Investigators, Vol. 16—Biological Studies. Juneau, Ak.
- King, J.G. (ed.). 1974. *Pelagic Studies of Seabirds in the Central and Eastern Pacific Ocean*. Washington, D.C.: Smithsonian Institution Press.
- \_\_\_\_\_ and C.J. Lensink. 1971. An evaluation of Alaska habitat for migratory birds. U.S. Dept. of Interior, Bureau of Sport Fisheries and Wildlife.
- \_\_\_\_\_, P.D. Christian, R.E. Gill, Jr., and L.M. Dresch. 1981. A quantitative catalogue of intertidal and nearshore bird habitats of the eastern Bering Sea. U.S. Fish and Wildlife Service, Juneau, Ak.

- Lensink, C.J., P.J. Gould, and G.A. Sanger. 1979. Population dynamics and trophic relationships of marine birds in the Gulf of Alaska. Outer Continental Shelf Environmental Assessment Program, Vol. II: Receptors—Birds. Juneau, Ak.
- Nysewander, D.R., D.J. Foresell, P.A. Baird, D.J. Shields, G.J. Weiler, and J.H. Kogan. 1982. Marine bird and mammal survey of the eastern Aleutian Islands, summers of 1980-81. U.S. Fish and Wildlife Service, Alaska Regional Office, Anchorage, Ak.
- Peterson, M.R. 1981. Populations, feeding ecology and molt of Steller's eiders. *Condor* 83:256-262.
- Sanger, G.A. 1983. Diets and food web relationships of seabirds in the Gulf of Alaska and adjacent marine regions. U.S. Fish and Wildlife Service—Migratory Bird Section, Anchorage, Ak.
- \_\_\_\_\_ and R.D. Jones, Jr. 1981. The winter feeding ecology and trophic relationship of marine birds in Kachemak Bay, Alaska. Outer Continental Shelf Environmental Assessment Program, Final Reports of Principal Investigators. Vol. 16—Biological Studies. Juneau, Ak.
- Sowls, A.L. 1978. Catalog of Alaskan seabird colonies. U.S. Fish and Wildlife Service, Biological Services Program. USFWS/OBS—78/78. Anchorage, Ak.
- Trapp, J.L. 1975. The distribution and abundance of seabirds along the Aleutian Islands and Alaska Peninsula, fall 1974. U.S. Fish and Wildlife Service unpublished report from Aleutian Islands National Wildlife Refuge.
- U.S. Fish and Wildlife Service. (no date). Unimak Island wilderness study: Aleutian Islands National Wildlife Refuge, Third Judicial District, Alaska. U.S. Bureau of Sport Fisheries and Wildlife.

## Chapter 9

- Alaska Department of Fish and Game (ADF&G). 1980. Marine resources of the North Aleutian Shelf proposed lease sale area (map). Scale 1:1,000,000.
- \_\_\_\_\_. 1982. Alaska Peninsula/Aleutian Islands areas 1982 finfish annual report. Div. of Commercial Fisheries, Kodiak, Ak.
- Bristol Bay Cooperative Management Plan (BBCMP). 1983. Public review draft, Bristol Bay cooperative management plan and draft environmental impact statement (including appendices). State of Alaska—U.S. Department of Interior. Prepared under the direction of the Bristol Bay Study Group, June 1983. Anchorage, Ak.
- Commercial Fisheries Entry Commission (CFEC). 1982(a). Alaska's fishing fleets: a compilation of data on residence of gear operators, vessel characteristics and fishery diversification patterns of some major Alaskan fishing fleets, 1969-1980. Juneau, Ak.
- \_\_\_\_\_. 1982(b). 1982 Annual report: Alaska Commercial Fisheries Entry Commission. Juneau, Ak.
- \_\_\_\_\_. 1983. Changes in the distribution of permit ownership in Alaska's limited entry fisheries, 1975-1981. Juneau, Ak.
- Earl R. Combs, Inc. 1981. St. George Basin and North Aleutian Shelf commercial fishing industry analysis. Alaska Outer Continental Shelf Socioeconomic Studies Program Technical Report No. 60. Anchorage, Ak.
- Moberly, S. 1983. Summary information on Russell Creek hatchery. Report to the Alaska Legislature, Alaska Dept. Fish and Game, Anchorage, Ak.
- Science Applications, Inc. 1981. North Aleutian shelf lease area. Unpublished report for U.S. Dept. Commerce, National Oceanic and Atmospheric Administration, and U.S. Dept. Interior, Bureau of Land Management. Boulder, Co.
- Shaul, A. 1983. Personal communication. Fisheries biologist, Alaska Dept. Fish and Game, Cold Bay, Ak.
- Smith, G.B. 1982. Commercial fish resources of the northwestern Gulf of Alaska (within proposed outer continental shelf sale 92, North Aleutian Basin)—with emphasis on sensitive areas and early life history stages. National Marine Fisheries Service, Northwest and Alaska Fisheries Center, Resource Assessment and Conservation Engineering Div. Seattle, Wa.
- Terry, J.M., R.G. Scoles, and D.M. Larson. 1980. Western Alaska and Bering-Norton petroleum development scenarios: commercial fishing industry analysis. Alaska Outer Continental Shelf Socioeconomic Studies Program Technical Report No. 51. Minerals Management Service, Anchorage, Ak.

## Chapter 10

Alaska Department of Fish and Game (ADF&G). 1980. Marine resources of the North Aleutian Shelf proposed lease sale area (map). Scale 1:1,000,000.

\_\_\_\_\_. 1982. Alaska Peninsula/Aleutian Islands areas 1982 finfish annual report. Div. of Commercial Fisheries, Kodiak, Ak.

Bristol Bay Cooperative Management Plan (BBCMP). 1983. Public review draft, Bristol Bay cooperative management plan and draft environmental impact statement (including appendices). State of Alaska—U.S. Department of Interior. Prepared under the direction of the Bristol Bay Study Group, June 1983. Anchorage, Ak.

Commercial Fisheries Entry Commission (CFEC). 1982(a). Alaska's fishing fleets: a compilation of data on residence of gear operators, vessel characteristics and fishery diversification patterns of some major Alaskan fishing fleets, 1969-1980. Juneau, Ak.

\_\_\_\_\_. 1982(b). 1982 Annual report: Alaska Commercial Fisheries Entry Commission. Juneau, Ak.

Earl R. Combs, Inc. 1981. St. George Basin and North Aleutian Shelf commercial fishing industry analysis. Alaska Outer Continental Shelf Socioeconomic Studies Program Technical Report No. 60. Anchorage, Ak.

Malloy, L. 1983. Personal communication. Fisheries biologist, Alaska Dept. Fish and Game, Kodiak, Ak.

Science Applications, Inc. 1981. North Aleutian shelf lease area. Unpublished report for U.S. Dept. Commerce, National Oceanic and Atmospheric Administration, and U.S. Dept. Interior, Bureau of Land Management. Boulder, Co.

Smith, G.B. 1982. Commercial fish resources of the northwestern Gulf of Alaska (within proposed outer continental shelf sale 92, North Aleutian Basin)—with emphasis on sensitive areas and early life history stages. National Marine Fisheries Service, Northwest and Alaska Fisheries Center, Resource Assessment and Conservation Engineering Div. Seattle, Wa.

Terry, J.M., R.G. Scoles, and D.M. Larson. 1980. Western Alaska and Bering-Norton petroleum development scenarios: commercial fishing industry analysis. Alaska Outer Continental Shelf Socioeconomic Studies Program Technical Report No. 51. Minerals Management Service, Anchorage, Ak.

Tobolski, J. and S. Langdon. 1982. Alaska Peninsula socioeconomic and sociocultural systems analysis. Alaska Outer Continental Shelf Socioeconomic Studies Program Technical Report No. 71. Minerals Management Service, Anchorage, Ak.

## Chapter 11

Alaska Department of Fish and Game (ADF&G). 1980. Marine resources of the North Aleutian Shelf proposed lease sale area (map). Scale 1:1,000,000.

Best, E. 1983. Personal communication. International Pacific Halibut Commission, Seattle, Wa.

Bristol Bay Cooperative Management Plan (BBCMP). 1983. Public review draft, Bristol Bay cooperative management plan and draft environmental impact statement (including appendices). State of Alaska—U.S. Department of Interior. Prepared under the direction of the Bristol Bay Study Group, June 1983. Anchorage, Ak.

Commercial Fisheries Entry Commission (CFEC). 1982(a). Alaska's fishing fleets: a compilation of data on residence of gear operators, vessel characteristics and fishery diversification patterns of some major Alaskan fishing fleets, 1969-1980. Juneau, Ak.

\_\_\_\_\_. 1982(b). 1982 Annual report: Alaska Commercial Fisheries Entry Commission. Juneau, Ak.

Earl R. Combs, Inc. 1981. St. George Basin and North Aleutian Shelf commercial fishing industry analysis. Alaska Outer Continental Shelf Socioeconomic Studies Program Technical Report No. 60. Anchorage, Ak.

International Pacific Halibut Commission (IPHC). 1978. The Pacific halibut: biology, fishery, and management. IPHC Technical Report no. 16 (revision of no. 6). Seattle, Wa.

\_\_\_\_\_. 1979-1982. Annual reports. Seattle, Wa.

Science Applications, Inc. 1981. North Aleutian shelf lease area. Unpublished report for U.S. Dept. Commerce, National Oceanic and Atmospheric Administration, and U.S. Dept. Interior, Bureau of Land Management. Boulder, Co.

Smith, G.B. 1982. Commercial fish resources of the northwestern Gulf of Alaska (within proposed outer continental shelf sale 92, North Aleutian Basin)—with emphasis on sensitive areas and early life history stages. National Marine Fisheries Service, Northwest and Alaska Fisheries Center, Resource Assessment and Conservation Engineering Div. Seattle, Wa.

Terry, J.M., R.G. Scoles, and D.M. Larson. 1980. Western Alaska and Bering-Norton petroleum development scenarios: commercial fishing industry analysis. Alaska Outer Continental Shelf Socioeconomic Studies Program Technical Report No. 51. Minerals Management Service, Anchorage, Ak.

Tobolski, J. and S. Langdon. 1982. Alaska Peninsula socioeconomic and sociocultural systems analysis. Alaska Outer Continental Shelf Socioeconomic Studies Program Technical Report No. 71. Minerals Management Service, Anchorage, Ak.

## Chapter 12

Alaska Department of Fish and Game (ADF&G). 1980. Marine resources of the North Aleutian Shelf proposed lease sale area (map). Scale 1:1,000,000.

\_\_\_\_\_. 1982. Alaska Peninsula/Aleutian Islands areas 1982 finfish annual report. Div. of Commercial Fisheries, Kodiak, Ak.

\_\_\_\_\_. In Press. Southwest region regional guide. Groundfish life history map; groundfish human use map. Scale 1:1,000,000. Anchorage, Ak.

Bakkala, R.G. and L.L. Low. 1983. Condition of groundfish resources of the eastern Bering Sea and Aleutian Island region in 1982. National Oceanic and Atmospheric Administration, Technical Memorandum NMFS F/NWC-42.

Balsinger, J. (ed.) 1982. Condition of groundfish resources of the Gulf of Alaska in 1982. Unpublished report. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northwest and Alaska Fisheries Center. Seattle, Wa.

Bristol Bay Cooperative Management Plan (BBCMP). 1983. Public review draft, Bristol Bay cooperative management plan and draft environmental impact statement (including appendices). State of Alaska—U.S. Department of Interior. Prepared under the direction of the Bristol Bay Study Group, June 1983. Anchorage, Ak.

Cobb, J.N. 1916. Pacific cod fisheries. U.S. Dept. of Commerce, Bureau of Sport Fisheries. Document No. 830. Appendix IV to the report of the U.S. Commission of Fisheries for 1915. Washington, D.C.

Commercial Fisheries Entry Commission (CFEC). 1982(a). Alaska's fishing fleets: a compilation of data on residence of gear operators, vessel characteristics and fishery diversification patterns of some major Alaskan fishing fleets, 1969-1980. Juneau, Ak.

\_\_\_\_\_. 1982(b). 1982 Annual report: Alaska Commercial Fisheries Entry Commission. Juneau, Ak.

Earl R. Combs, Inc. 1981. St. George Basin and North Aleutian Shelf commercial fishing industry analysis. Alaska Outer Continental Shelf Socioeconomic Studies Program Technical Report No. 60. Anchorage, Ak.

Fisher, B. 1980. The joint venture fishery for yellowfin sole: the Bering Sea, summer 1980. A case study in fishery development. Prepared for Alaska Fisheries Development Foundation and North Pacific Fisheries Management Council. Anchorage, Ak.

Natural Resource Consultants. 1981. The Pacific cod (*Gadus macrocephalus*) opportunities for the 1980's. Report of the Economic Development Council of Puget Sound. Seattle, Wa.

North Pacific Fisheries Management Council (NPFMC). 1979(a). Fisheries management plan for the Gulf of Alaska groundfish fishery. Anchorage, Ak.

- \_\_\_\_\_. 1979(b). Fishery management plan for the groundfish fishery in the Bering Sea/Aleutian Island area. Anchorage, Ak.
- \_\_\_\_\_. 1983(a). Summary of Gulf of Alaska groundfish management plan (through amendment 12). Anchorage, Ak.
- \_\_\_\_\_. 1983(b). Summary of Bering Sea/Aleutian Islands groundfish fishery management plan (through amendment 8). Anchorage, Ak.
- Science Applications, Inc. 1981. North Aleutian shelf lease area. Unpublished report for U.S. Dept. Commerce, National Oceanic and Atmospheric Administration, and U.S. Dept. Interior, Bureau of Land Management. Boulder, Co.
- Smith, G.B. 1982. Commercial fish resources of the northwestern Gulf of Alaska (within proposed outer continental shelf sale 92, North Aleutian Basin)—with emphasis on sensitive areas and early life history stages. National Marine Fisheries Service, Northwest and Alaska Fisheries Center, Resource Assessment and Conservation Engineering Div. Seattle, Wa.
- \_\_\_\_\_. R.G. Hadley, R. French, R. Nelson, Jr., and J. Wall. 1980. A summary of productive foreign fishing locations in the Alaska region during 1977-79; longline fisheries. Alaska Sea Grant Report 80-1. Fairbanks, Ak.
- \_\_\_\_\_. R.S. Hadley, R. French, R. Nelson, Jr., and J. Wall. 1981. A summary of productive foreign fishing locations in the Alaska region during 1977-80; trawl fisheries. Alaska Sea Grant Report 81-4. Fairbanks, Ak.
- Wepestad, V.G., R. Nelson, and B. Gibbs. 1982. Distribution of groundfish catches of the foreign trawl and longline fisheries in the eastern Bering Sea and Gulf of Alaska, 1977-80. National Oceanic and Atmospheric Administration Technical Memorandum NMFS F/NWC-31.

## Chapter 13

- Alaska Department of Fish and Game (ADF&G). 1980. Marine resources of the North Aleutian Shelf proposed lease sale area (map). Scale 1:1,000,000.
- \_\_\_\_\_. 1983. Westward region shellfish report to the Alaska Board of Fisheries. Div. of Commercial Fisheries, Westward Regional Office, Kodiak, Ak.
- Bristol Bay Cooperative Management Plan (BBCMP). 1983. Public review draft, Bristol Bay cooperative management plan and draft environmental impact statement (including appendices). State of Alaska—U.S. Department of Interior. Prepared under the direction of the Bristol Bay Study Group, June 1983. Anchorage, Ak.
- Commercial Fisheries Entry Commission (CFEC). 1982(a). Alaska's fishing fleets: a compilation of data on residence of gear operators, vessel characteristics and fishery diversification patterns of some major Alaskan fishing fleets, 1969-1980. Juneau, Ak.
- \_\_\_\_\_. 1982(b). 1982 Annual report: Alaska Commercial Fisheries Entry Commission. Juneau, Ak.
- Curl, H.E. and C.A. Manen. 1982. Shellfish resources. In: H.J. Hameedi (ed.) *The St. George Basin Environment and Possible Consequences of Planned Offshore Oil and Gas Development*. U.S. Dept. Commerce, National Oceanic and Atmospheric Administration, Office of Marine Pollution Assessment. Outer Continental Shelf Environmental Assessment Program. Juneau, Ak.
- Earl R. Combs, Inc. 1981. St. George Basin and North Aleutian Shelf commercial fishing industry analysis. Alaska Outer Continental Shelf Socioeconomic Studies Program Technical Report No. 60. Anchorage, Ak.
- Hughes, S. and N. Bourne. 1981. Stock assessment of life history of a newly discovered Alaska surf clam resource in the southeastern Bering Sea. In: D.W. Hood and J.A. Calder (eds.) *The Eastern Bering Sea Shelf: Oceanography and Resources*. Vol. II. National Oceanic and Atmospheric Administration, Office of Marine Pollution Assessment. Seattle, Washington: Univ. of Washington Press.

- North Pacific Fisheries Management Council (NPFMC). 1981(a). Bering Sea/Aleutian Islands king crab draft environmental impact statement and fishery management plan. Anchorage, Ak.
- \_\_\_\_\_. 1981(b). Commercial tanner crab fishery off the coast of Alaska. Anchorage, Ak.
- \_\_\_\_\_. 1982. Bering Sea/Aleutian Islands king crab fishery management plan. Anchorage, Ak.
- Science Applications, Inc. 1981. North Aleutian shelf lease area. Unpublished report for U.S. Dept. Commerce, National Oceanic and Atmospheric Administration, and U.S. Dept. Interior, Bureau of Land Management. Boulder, Co.
- Smith, G.B. 1982. Commercial fish resources of the northwestern Gulf of Alaska (within proposed outer continental shelf sale 92, North Aleutian Basin)—with emphasis on sensitive areas and early life history stages. National Marine Fisheries Service, Northwest and Alaska Fisheries Center, Resource Assessment and Conservation Engineering Div. Seattle, Wa.
- Terry, J.M., R.G. Scoles, and D.M. Larson. 1980. Western Alaska and Bering-Norton petroleum development scenarios: commercial fishing industry analysis. Alaska Outer Continental Shelf Socioeconomic Studies Program Technical Report No. 51. Minerals Management Service, Anchorage, Ak.
- Thorsteinson, L.K. (ed.). 1984. The north Aleutian shelf environment and possible consequences of planned offshore oil and gas development (draft). Proceedings of a synthesis meeting, March 9-11, 1982, Anchorage, Ak. Outer Continental Shelf Environmental Assessment Program. Juneau, Ak.
- Tobolski, J. and S. Langdon. 1982. Alaska Peninsula socioeconomic and sociocultural systems analysis. Alaska Outer Continental Shelf Socioeconomic Studies Program Technical Report No. 71. Minerals Management Service, Anchorage, Ak.

## Chapter 14

- Aleutians Region School District. 1982. *Taniisix*. Vol. III. A&T Publishing. Anchorage, Ak.
- Arctic Environmental Information and Data Center (AEIDC). 1976. Alaska regional profiles: southwest region. Report for the Office of the Governor, Juneau, Ak.
- Cenaliuritt Coastal Management District. 1982. The history and culture of the Yupik. Chap. 2 *In*: Cenaliuritt Coastal Management Program, Public Hearing Draft. Nunam Kitlutsisti, Bethel, Ak.
- Collins, H.B. et al. 1945. *The Aleutian Islands: Their People and Natural History*. Smithsonian Institution War Background Studies No. 21.
- Gross, J.J. and S. Khera. 1980. Ethnohistory of the Aleuts. Alaska State Historical Commission. Univ. of Alaska. Fairbanks, Ak.
- Jones, D. 1973. Patterns of village growth and decline in the Aleutians. Univ. of Alaska, Institute of Social and Economic Research, Occasional Papers No. 11. Fairbanks, Ak.
- Langdon, S.F. 1982. Alaska outer continental shelf socioeconomic studies program: Alaska Peninsula socioeconomic and sociocultural systems analysis. Minerals Management Service, Technical Report 71. Anchorage, Ak.
- Stein, G.C. 1977. Cultural resources of the Aleutian region. Vols. I and II, Anthropology and Historic Preservation Cooperative Park Studies Unit, Univ. of Alaska, Fairbanks, Ak.

## Chapter 15

- Alaska Department of Natural Resources (ADNR). 1983. Alaska Heritage Resources Survey sites. Mapped information. Div. of Parks, History and Archeology. Anchorage, Ak.
- McCartney, A.P. 1973. 1972 Archeological site survey in the Aleutian Islands, Alaska. *In*: Conference on the prehistory and paleoecology of U.S. Department of Interior (USDI), Bureau of Indian Affairs. 1983. Sec. 14(h)1 cultural and historic sites. Mapped information. Realty Office, Anchorage, Ak.
- Western North American Arctic and Subarctic. Univ. of Calgary Archeological Association. pp. 113-126.

## Chapter 16

Arctic Environmental Information & Data Center 1978, community profiles for False Pass, Nelson Lagoon, Belkofski; Alaska Department of Community and Regional Affairs, Anchorage, Alaska; Dowl Engineers, community profile for Cold Bay, Anchorage, Alaska.

City of King Cove. 1981. City of King Cove community comprehensive plan. Ordinance 81-2. January 1981.

City of Sand Point. 1981. City of Sand Point community comprehensive plan. Ordinance 81-4. January 1981.

Langdon, S.F. 1982. Alaska outer continental shelf socioeconomic studies program: Alaska Peninsula socioeconomic and sociocultural systems analysis. Minerals Management Service, Technical Report 71. Anchorage, Ak.

Nebesky, W.N., S. Langdon, and T. Hall. 1983. Economic, subsistence, and sociocultural projections in the Bristol Bay region. Vols. I and II. Bristol Bay Cooperative Management Plan and Refuge Comprehensive Plan.

Petterson, J.S., L.A. Palinkas, and B.M. Harris. 1982. Alaska outer continental shelf socioeconomic studies program: North Aleutian shelf non-OCS forecast analysis. Minerals Management Service, Technical Report No. 75. Anchorage, Ak.

## Chapter 17

U.S. Department of Interior, Bureau of Land Management. 1980. Alaska Native Claims Settlement Act of 1971 and amendments 1973-1979, Section 14.

## Chapter 18

Barnett, J.A. (ed.). 1983. Annual report of survey—inventory activities. Part II: Caribou. Report for Alaska Dept. Fish and Game, Juneau, Ak.

Bristol Bay Cooperative Management Plan (BBCMP). 1983. Public review draft, Bristol Bay cooperative management plan and draft environmental impact statement (including appendices). State of Alaska—U.S. Department of Interior. Prepared under the direction of the Bristol Bay Study Group, June 1983. Anchorage, Ak.

Glenn, L. 1983. Personal communication. Alaska Dept. Fish and Game, Anchorage, Ak.

Grumholt, P. 1983. Personal communication. Peninsula Marketing Association, Sand Point, Ak.

Hinman, R.A. 1982. Annual report of survey—inventory activities. Part I. Black bears and brown bears, Vol. XIII. Alaska Dept. Fish and Game, Federal Aid in Wildlife Restoration. Juneau, Ak.

Langdon, S.F. 1982. Alaska outer continental shelf socioeconomic studies program: Alaska Peninsula socioeconomic and sociocultural systems analysis. Minerals Management Service, Technical Report 71. Anchorage, Ak.

Lobb, J. 1983. Personal communication. Alaska Dept. Public Safety, Anchorage, Ak.

Mills, M.J. 1983. Annual performance report for Alaska statewide sport fish harvest studies—1982 data. Vol. 24. Alaska Dept. Fish and Game, Juneau, Ak.

Mooring, R. 1983. Personal communication. Alaska Dept. Fish and Game, Anchorage, Ak.

Timm, D. 1972. Report of survey and inventory activities: waterfowl hunter mail questionnaire survey 1971-1972. Ak. Dept. Fish and Game. Amendment to Vol. III, Federal Aid in Wildlife Restoration. Juneau, Ak.

\_\_\_\_\_. 1974. Report of survey and inventory activities: waterfowl hunter mail questionnaire survey 1973-1974. Vol. V, Ak. Dept. Fish and Game, Federal Aid in Wildlife Restoration. Juneau, Ak.

\_\_\_\_\_. 1975. Report of survey and inventory activities: waterfowl hunter mail questionnaire survey 1974-1975. Vol. VI, Ak. Dept. Fish and Game, Federal Aid in Wildlife Restoration. Juneau, Ak.

\_\_\_\_\_. 1976. Report of survey and inventory activities: waterfowl hunter mail questionnaire survey 1975-1976. Vol. VII, Ak. Dept. Fish and Game, Federal Aid in Wildlife Restoration. Juneau, Ak.

\_\_\_\_\_. 1977. Report of survey and inventory activities: waterfowl hunter mail questionnaire survey 1976-1977. Vol. VIII, Ak. Dept. Fish and Game, Federal Aid in Wildlife Restoration. Juneau, Ak.

\_\_\_\_\_ and P. Havens. 1973. Report of survey and inventory activities: waterfowl hunter mail questionnaire survey 1972-1973. Vol. IV, Ak. Dept. Fish and Game, Federal Aid in Wildlife Restoration. Juneau, Ak.